Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE)

SDSFIE Metadata (SDSFIE-M): Implementation Specification (SMIS)

Version 1.0.2

(28 AUGUST 2014)

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Executive Summary

Metadata, data about data, is important and valuable because it enables discovery of information. It can be an aid to data and system interoperability. Metadata describes the source, methods, content and the appropriate use of a data or service. As archived data and imagery grow to enormous volumes, metadata is becoming even more critical. Without good metadata, a consumer may not be able to search and retrieve data containing the characteristics and content necessary to support their mission. Metadata should improve data accountability and limit data liability. The timely capture of metadata is also fundamental to the quality of the data resource as a whole.

For geospatial datasets, accurate, complete and descriptive geospatial metadata is a key component and is needed by a rapidly growing geospatial data community to locate available geospatial data and services. Metadata should enable the user to assess quality and lineage, allowing the appropriate understanding, use and exploitation of geospatial data. Certain geospatial metadata is also used in the DoD Installations and Environment (I&E) community to specify the structure and characteristics of I&E data.

In general, geospatial metadata should describe the data elements used to specify information about features, events, coverages (including, images and elevation surfaces), datasets (collections of similar information) and services (capabilities to create, access, display, and/or manipulate information). Geospatial metadata should also specify characteristics of the values of data items (e.g., the accuracy of a measured height value or the analytic confidence a type-assignment is correct) and characteristics of datasets (the producer, release date, content summary and the like). In order for a geospatial data resource to be discovered, assessed for its fitness of use, retrieved, and then exchanged, it should comply with certain DoD and international standards that mandate the structure and content of metadata for geospatial information. All the diverse metadata requirements within these various standards appropriate for compliance in I&E systems have been brought together under a single umbrella reference standard for ease of use in the I&E community. Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE) Metadata (SDSFIE-M) is a standard which defines the conceptual schema profile for specifying geospatial metadata in and for the I&E community. It is the policy of the Deputy Under Secretary of Defense for Installations and Environment that all I&E geospatial data have accompanying metadata, conforming to DoD standards. SDSFIE-M is that standard for the I&E community. A separate, but related document defines the mandatory and common elements of the conceptual schema for SDSFIE-M (SDSFIE-Metadata: Conceptual Schema). This document contains the XML schema implementation of SDSFIE-M, and is called the SDSFIE Metadata Implementation Schema (SMIS). Implementation guidance is defined in a separate SDSFIE-M Implementation Guidance document.

Revision History

Description	Date	Version
Initial DISDIG Approved Version (version number aligned with SDSFIE-M Conceptual Schema)	August 28, 2014	1.0.2

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Introduction

The term **Geospatial** refers to either an implicit or explicit reference to a location relative to the earth.

Metadata is information which captures the underlying characteristics of a resource. In general it represents the who, what, when, where, why, and how of the resource.

The term **Geospatial Information & Services** – or **GI&S** – encompasses the concept for collection, information extraction, storage, dissemination, and exploitation of geodetic, geomagnetic, imagery, gravimetric, aeronautical, topographic, hydrographic, littoral, cultural, and toponymic data accurately referenced to a precise location on the earth's surface[1]. These data are used in the battlespace for military planning, training, and operations, including navigation, mission planning, mission rehearsal, modeling, simulation, and precise targeting, as well as in the basing space to provide situational awareness for force protection and management of the built and natural infrastructure.

For the purposes of this specification, **Installation GI&S (IGI&S)** are the subset of GI&S activities used to perform I&E management, civil works management. IGI&S is expected to enhance the DoD I&E Business Mission Area and support DoD business transformation by addressing business enterprise priorities, as defined in the DoD BEA. IGI&S pertain to installations and sites as defined in DoDI 4165.14[2] and do not apply to contingency locations as defined in DoDD 3000.10[3]. IGI&S supports and is enabled by geospatial engineering and general engineering as defined in Joint Publication 3-34[4]. IGI&S is managed as a DoD information resource and information technology as defined in EO 12906[5], DoD Directives 8000.01[6] and 8115.01[7].

Geospatial information provides the basic framework for IGI&S business mission support. It is location-based information produced by one or more sources that should follow adopted interoperable data standards. Geospatial data may be utilized in the form of printed maps, charts, and publications; in digital simulation and modeling databases; in photographic form; or in the form of digitized maps and charts or attributed centerline data as well as other forms. Geospatial services include tools that enable users to access and manipulate data. These services can also include instruction, training, laboratory support, and guidance for its use.

The SDSFIE-M defines a Conformance Class 2 profile[8] of NMF (which is , in turn, itself a Conformance Class 2 profile of ISO 19115:2003/Cor 1:2006) for specifying geospatial metadata documenting geospatial information and services in the I&E business mission area.

The goals of SDSFIE-M across I&E business mission area are to :

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[1] Joint Publication (JP) 2-03, 31 Oct 2012.

[2] DoD Instruction 4165.14, "Real Property Inventory (RPI) Forecasting," January 17, 2014

[3] DoD Directive 3000.10, "Contingency Basing Outside the United States." January 10, 2013

[4] Joint Publication (JP) 3-34, "Joint Engineer Operations," 30 June, 2011

[5] Executive Order 12906, "Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure," April 11, 1994

[6] DoD Directive 8000.01, "Management of the Department of Defense Information Enterprise," February 10, 2009

[7] DoD Directive 8115.01, "Infromation Technology Portfolio Management," October 10, 2005

[8] ISO 19106:2004 *Geographic information - Profiles* details two classes of conformance, which may be generally thought of as profile types. Conformant Class 1 profiles are a pure subset of the ISO geographic information standards. Conformance class 2 allows profiles to include extensions within the context permitted in the base standard and permits the profiling of non-ISO geographic information standards as parts of profiles.

- Enable a common understanding of geospatial metadata ;
- Define the conceptual specification standard for geospatial metadata;
- Establish the foundation standard defining business rules for specifying geospatial metadata;
- Define the logical specification standard for geospatial metadata;
- Promote the re-use and standardization of geospatial metadata;
- Encourage the harmonization of geospatial metadata, supporting varying business requirements and practices;
- Define the physical specification(s) standard for geospatial metadata with multiple COTS technologies, including standards-based exchange; and
- Establish the geospatial metadata publication standard using externally-specified specifications and mechanisms.

A note on terminology

SDSFIE-M uses the Unified Markup Language (UML) to model a conceptual schema. This mixture of techniques may lead to some confusion of terms. A conceptual schema consists of metadata entities composed of elements. A UML model is composed of classes containing attributes. An effort has been made to use the terminology appropriate for the context. However, it is best to remember that:

1) Entities are concepts modeled by classes
2) Classes are models representing concepts
3) Elements are concepts modeled by attributes
4) Attributes are models representing elements.

SDSFIE Metadata Implementation Specification

1 Scope

This SDSFIE Metadata Implementation Specification (SMIS) specifies an Extensible Markup Language (XML) encoding of the *SDSFIE Metadata (SDSFIE-M): Conceptual Schema* that is conformant to ISO/TS 19139 *Geographic information – Metadata – XML schema implementation*, the *XML Data Encoding Specification for Information Security Marking Metadata* (DES.ISM.XML.V9), and the *XML Data Encoding Specification for Need-To-Know Metadata* (DES.NTK.XML.V7) for use in the documentation, discovery and exchange of geospatial datasets in the I&E community. This encoding shall be used to document geospatial datasets for cataloguing, discovery and retrieval.

2 Conformance

Conformance with the SDSFIE Metadata Implementation Specification shall be checked using all of the relevant tests specified in Annex A.

3 References

3.1 *Normative*

The documents listed in Table 1 are indispensable to understanding and using this standard. For dated references, only the cited edition or version applies. For undated references, the latest edition or version of the referenced document (including any amendments) applies.

Table 1 – Normative References

Standard or Specification
ISO 639-2:1998, *Codes for the representation of names of languages – Part 2: Alpha-3 code*
ISO 3166-1:2006, *Codes for the representation of names of countries and their subdivisions – Part 1: Country codes*
ISO 3166-2:1998, *Codes for the representation of names of countries and their subdivisions – Part 2: Country subdivision code*
ISO 8601:2004, *Data elements and interchange formats – Information interchange – Representation of dates and times*
ISO 80000-1:2009, *Quantities and units - Part 1: General*
ISO 19136:2007, *Geographic information – Geography Markup Language (GML)* https://nsgreg.nga.mil/doc/view?i=2016 (same as: Geography Markup Language Version 3.2.1 (OGC 07-036))
ISO/TS 19139:2007, *Geographic information – Metadata – XML schema implementation*
ISO/TS 19139-2:2012, *Geographic information -- Metadata -- XML schema implementation -- Part 2: Extensions for imagery and gridded data*
XML Schema Part 1: Structures (Second Edition), 28 October 2004: http://www.w3.org/TR/2004/REC-xmlschema-1-20041028/
XML Schema Part 2: Datatypes (Second Edition), 28 October 2004: http://www.w3.org/TR/2004/REC-xmlschema-2-20041028/

Standard or Specification
ISO/IEC 19757:2006, *Information Technology – Document Schema Definition Language (DSDL) – Part 3: Rule-based validation – Schematron* http://standards.iso.org/ittf/PubliclyAvailableStandards/c040833_ISO_IEC_19757-3_2006(E).zip
ITU-T Recommendation E.123, SERIES E: OVERALL NETWORK OPERATION, TELEPHONE SERVICE, SERVICE OPERATION AND HUMAN FACTORS, International operation – General provisions concerning users, Notation for national and international telephone numbers, e-mail addresses and web addresses, February 2001 http://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-E.123-200102-I!!PDF-E&type=items
IETF RFC 2046, *Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types* http://www.ietf.org/rfc/rfc2046.txt
IETF RFC 4646, *Tags for Identifying Languages* http://www.ietf.org/rfc/rfc4646.txt
FIPS 10-4:1995, *Countries, Dependencies, Areas of Special Sovereignty, and Their Principal Administrative Divisions*, as amended through Change Notice 14: 2008-07-31 http://earth-info.nga.mil/gns/html/gazetteers2.htm
NIMA TR8350.2, DoD World Geodetic System 1984 – Its Definition and Relationships with Local Geodetic Systems, Third Edition, Amendment 1, 3 January 2000 http://earth-info.nga.mil/GandG/publications/tr8350.2/tr8350_2.html
DMA TM8358.1, Datums, Ellipsoids, Grids, and Grid Reference Systems, September 1990 http://earth-info.nga.mil/GandG/publications/tm8358.1/toc.html
DMA TM8358.2, The Universal Grids: Universal Transverse Mercator (UTM) and Universal Polar Stereographic (UPS), September 1989 http://earth-info.nga.mil/GandG/publications/tm8358.2/TM8358_2.pdf
Earth Gravity Model EGM2008, April 2008 http://earth-info.nga.mil/GandG/wgs84/gravitymod/egm2008/egm08_wgs84.html
XML Data Encoding Specification for Information Security Marking Metadata, Version 9 (DES.ISM.XML.V9), 17 July 2012 http://www.dni.gov/files/documents/CIO/ICEA/ISMPublic.zip
XML Data Encoding Specification for Need-To-Know Metadata, Version 7 (DES.NTK.XML.V7), 17 July 2012 http://www.dni.gov/files/documents/CIO/ICEA/NTKPublic.zip
SDSFIE Metadata (SDSFIE-M): Conceptual Schema, version 1.0.2, 28 August, 2014 http://metadata.ces.mil/dse/ns/DISDI/smis/SDSFIE-M-20140828-v1.0.2.pdf

3.2 *Informative*

The informative (non-normative) documents listed in Table 2 are useful to understanding and using this standard. For dated references, only the cited edition or version applies.

Table 2 – Informative References

Standard or Specification
ISO 19105:2000, *Geographic information – Conformance and testing*
ISO 19106:2004, *Geographic information – Profiles*
ISO 19107:2003, *Geographic information – Spatial schema*
ISO 19108:2002, *Geographic information – Temporal schema*
ISO 19111:2007, *Geographic information – Spatial referencing by coordinates*
ISO 19115:2003, *Geographic information – Metadata*
ISO 19115:2003/Cor. 1:2006, *Geographic information – Metadata – Corrigendum 1*
ISO 19115-2:2009, *Geographic information -- Metadata -- Part 2: Extensions for imagery and gridded data*
ISO 80000-3:2006, *Quantities and units - Part 3: Space and time*
ISO 80000-4:2006, *Quantities and units - Part 4: Mechanics*
IEC 80000-6:2008, *Quantities and units - Part 6: Electromagnetism*
ISO 80000-7:2008, *Quantities and units - Part 7: Light*
IETF RFC 2045, *Multipurpose Internet Mail Extensions (MIME) Part One: Format of Internet Message Bodies* http://www.ietf.org/rfc/rfc2045.txt
IETF RFC 2047, *Multipurpose Internet Mail Extensions (MIME) Part Three: Message Header Extensions for Non-ASCII Text* http://www.ietf.org/rfc/rfc2047.txt
NIST Special Publication 811, Ed. 2008, Guide for the Use of the International System of Units (SI) http://physics.nist.gov/cuu/pdf/sp811.pdf
Intelligence Community Abstract Data Definition, Version 2 (IC.ADD.V2), 9 August 2011, *Chapter 3 – Information Security Marking Data Elements* http://www.dni.gov/files/documents/CIO/ICEA/IC-ADD%209%20Aug%202011.pdf
National System for Geospatial Intelligence (NSG) Metadata Foundation (NMF) – Part 1: *Conceptual Schema Profile*, version 2.1, 26 March 2012, https://nsgreg.nga.mil/doc/view?i=2306
National System for Geospatial Intelligence Metadata Implementation Specification (NMIS) - Part 2: XML Exchange Schema, Version 2.1.0, 31 October 2012, https://nsgreg.nga.mil/doc/view?i=82074
National System for Geospatial Intelligence Metadata Implementation Specification (NMIS) - Part 2: XML Exchange Schema, Version 2.0.0, 16 December 2010, https://nsgreg.nga.mil/doc/view?i=82072

4 Terms, Acronyms and Basic Data Types

4.1 *Terms*

The terms and definitions specific to this standard are specified in the following list.

data resource

asset including data instances that fulfills a requirement

NOTE A data resource may be implemented either as a physically-segregated collection of data instances (*e.g.*, as a data product) or as a virtual collection based on a dynamic filter (*e.g.*, as the result of a well-formed query submitted to a data service) applied to a larger collection of data instances.

metadata

data about data [ISO 19115]

metadata element

discrete unit of metadata [ISO 19115]

NOTE 1 Metadata elements are unique within a metadata entity.
NOTE 2 Equivalent to an attribute in UML terminology.

metadata entity

set of metadata elements describing the same aspect of data [ISO 19115]

NOTE 1 May contain one or more metadata entities.
NOTE 2 Equivalent to a class in UML terminology.

metadata section

subset of metadata which consists of a collection of related metadata entities and metadata elements [ISO 19115]

NOTE Equivalent to a package in UML terminology.

resource

asset or means that fulfills a requirement

EXAMPLE Dataset, service, document, person or organization.

4.2 *Acronyms*

The acronyms that are used in this standard are specified in the following list.

CAPCO	Controlled Access Program Coordination Office (US)
CRS	Coordinate Reference System
CVE	Controlled Vocabulary Enumeration
DES	Data Encoding Specification
DIL	Disconnected, Intermittent, or Low-bandwidth
DoD	Department of Defense (US)
DSE	DoD Data Services Environment (DSE)
FIPS	Federal Information Processing Standard (US)
GEOINT	Geospatial Intelligence
GML	Geography Markup Language
GPAS	Geospatial Publicly Available Specifications

GSIP	GEOINT Structure Implementation Profile
IC	Intelligence Community (US)
IEC	International Electrotechnical Commission
IETF	Internet Engineering Task Force
ISM	Information Security Marking
ISO	International Organization for Standardization
ITU	International Telecommunications Union
MIME	Multipurpose Internet Mail Extensions
NSG	National System for Geospatial Intelligence (US)
NTK	Need-To-Know
OCL	Object Constraint Language
ODNI	Office of the Director of National Intelligence
OGC	Open Geospatial Consortium
RFC	Request for Comments
SMTP	Simple Mail Transfer Protocol
SRS	Spatial Reference System
TLM	Topographic Line Map
UML	Unified Modeling Language
URI	Uniform Resource Identifier
URN	Uniform Resource Name
US	United States
UTC	Coordinated Universal Time
UUID	Universally Unique Identifier
WGS 84	World Geodetic System 1984
WGS84EGM96	WGS 84 Earth Gravity Model 1996
XML	Extensible Markup Language
XSD	XML Schema Definition
XSLT	Extensible Stylesheet Language Transformation

4.3 *Basic Data Types*

The basic data types used in this standard are specified in the following list.

CharacterString

character string with optional character encoding and localization attributes

CodeList

value domain including a code for each permissible value

NOTE It is an open Enumeration that may be extended during system runtime by adding additional named literal values.

Date

indication of date expressed as a year, year-month, or year-month-day

DateTime

indication of time expressed as a year, year-month, year-month-day, or year-month-day and time of day

Enumeration

data type whose instances form a finite list of distinguished values

NOTE 1 The extension of an Enumeration type implies a schema modification.
NOTE 2 An Enumeration should be used only when it is clear that there will be no extensions, otherwise a CodeList should be used.

Integer

whole number (a number that does not have a fractional part)

Real

a signed real (floating point) number consisting of a mantissa and an exponent, which represents a value to a precision given by the number of digits shown, but is not necessarily the exact value [ISO19103]

URI

Uniform Resource Identifier corresponding to the W3C recommendation

URL

Uniform Resource Location corresponding to the W3C recommendation

5 XML Encoding Schema

5.1 *Introduction*

The application schema specified by the SDSFIE Metadata: Conceptual Schema (SDSFIE-M) is a platform-independent model for geospatial metadata. In order to ensure unambiguous and loss-less exchange of data discovery and exchange metadata, a physical data model (encoding schema) is specified.

I&E applications will likely store geospatial metadata using the same technology used to store their geospatial data, *e.g.,* Relational Database Management Systems (RDBMS); the physical data model (encoding schema) specified here is thus only one of many possible platform-specific models conforming to SDSFIE-M.

The SMIS specifies an XML grammar written in XML Schema based on the requirements established in SDSFIE-M. This section specifies how the SMIS applies, in its encoding schema, the:

- ISO/TS 19139:2007 *Metadata – XML schema implementation*;
- ISO 19136:2007 *Geographic Markup Language* (GML);
- XML Data Encoding Specification for Information Security Marking Metadata, Version 9 (DES.ISM.XML.V9); and
- XML Data Encoding Specification for Need-To-Know Metadata, Version 7 (DES.NTK.XML.V7).

This XML-based encoding of the application schema specified by the SMIS will typically be used "stand-alone", however it is specifically intended to integrate with adaptations of SDSFIE Vector Schema (SDSFIE-V)[9]. In particular, an implementation of SDSFIE-M (and SMIS) is expected to exist at the time of publication of this document (SDSFIE Metadata Style for ArcGIS 10.1 (SP1)) so it can work with geodatabases built from SDSFIE-V.

The SMIS follows the naming and design rules set forth in Annex B.1. These are based on the requirements of ISO 19136 where not in conflict with requirements established by ISO/TS 19139.

5.2 *XML Namespaces*

A namespace provides a simple method for qualifying element and attribute names used in XML documents by associating them with namespaces identified by URI references. They are the primary mechanism for preventing name collisions in and across schemas.

Table 3 specifies the XML namespaces used in the SMIS and identifies the standard to which each corresponds. The **XML Namespace** is identified by a **Prefix**, an accompanying namespace **URI**, and a **Name** for that namespace. The final column, **Standard**, indicates the document whose conceptual schema the namespace is used to partially or fully encode as an XML schema.

Table 3 – XML Namespaces used in the SMIS

XML Namespace			Standard
Prefix	**URI**	**Name**	
gmd	http://www.isotc211.org/2005/gmd	**G**eographic **M**eta**D**ata	ISO 19115:2003/Cor 1:2006
gmi	http://www.isotc211.org/2005/gmi	**G**eographic **M**etadata **I**magery	ISO 19115-2:2009
gco	http://www.isotc211.org/2005/gco	**G**eographic **CO**mmon	ISO/TS 19103:2005
gss	http://www.isotc211.org/2005/gss	**G**eographic **S**patial **S**chema	ISO 19107:2003
gsr	http://www.isotc211.org/2005/gsr	**G**eographic **S**patial **R**eferencing	ISO 19111:2007
gts	http://www.isotc211.org/2005/gts	**G**eographic **T**emporal **S**chema	ISO 19108:2002/Cor 1:2006

[9] SDSFIE-V is the vector data model which current users recognize as "SDSFIE", including the most recent versions 2.6, 3.0, and 3.1.

XML Namespace			Standard
Prefix	**URI**	**Name**	
gml	http://www.opengis.net/gml/3.2 (*or http://www.opengis.net/gml*[10])	**G**eography **M**arkup **L**anguage	ISO 19136:2007
xlink	http://www.w3.org/1999/xlink	**X**ML **LINK**ing Language	W3C XLink Recommendation
ism	urn:us:gov:ic:ism	**I**nformation **S**ecurity **M**arkings	DES.ISM.XML
ntk	urn:us:gov:ic:ntk	**N**eed-**T**o-**K**now	DES.NTK.XML
sdsfie	http://metadata.ces.mil/dse/ns/DISDI/sdsfie	**S**patial **D**ata **S**tandards for **F**acilities, **I**nfrastructure, and **E**nvironment	SDSFIE-V, version 3.1

ISO/TS 19139 specifies an XML grammar written in XML Schema (XSD) that encodes the full ISO 19115 metadata application schema using the XML namespace prefix '**gmd**'.

ISO/TS 19139-2 specifies an XML grammar written in XML Schema (XSD) that encodes the full ISO 19115-2 metadata application schema using the XML namespace prefix '**gmi**'.

In addition, ISO/TS 19139 specifies an XML grammar for portions of other ISO 19100-series standards. These additional XSD files employ separate, unique XML namespaces; the prefix values listed are those used in ISO/TS 19139 and are the preferred values: '**gco**', '**gss**', '**gsr**' and '**gts**'. In each case, the XSD file(s) in the namespace encode that portion of the ISO 19100-series document that is used by ISO 19115:2003/Cor. 1:2006.

ISO 19136 specifies an XML grammar written in XML Schema for the description of application schemas as well as the transport and storage of geographic information using the XML namespace prefix '**gml**'.

The DES.ISM.XML schema used in the XML encoding of the SMIS defines the XML namespace prefix '**ism**'.

The DES.NTK.XML schema used in the XML encoding of the SMIS defines the XML namespace prefix '**ntk**'.

The SMIS XML-based encoding is specifically intended to integrate with the SDSFIE and uses the existing version-based SDSFIE XML namespace prefix '**sdsfie**'. The SMIS does not define its own XML namespace.

XML namespaces, and their associated technical artifacts, that correspond to publicly available standards/specifications are managed as resources hosted in the DISDI Governance Namespace of the DoD Data Services Environment (DSE). The structure and content of the DISDI Governance Namespace is described in a document entitled "*DISDI Governance Namespace Description*" at "**http://metadata.ces.mil/dse/ns/DISDI**".

5.3 *SMIS Versioning*

Versioning of the SMIS XML-based encoding follows Open Geospatial Consortium (OGC) policy as stated in 06-135r7 (http://portal.opengeospatial.org/files/?artifact_id=33115). A three-level

[10] The XML namespace GML 3.1 and earlier does not include a version number. Starting with GML 3.2 (ISO 19136), the namespace includes a version number. The XML namespace used by *smis.xsd, smisGmdProfile.xsd,* and *smisGmiProfile.xsd* must agree with each other and with the XML namespace of the version of GML being used. The SMIS XML schema is compatible with both GML 3.1 and GML 3.2.

version pattern is used, where major, minor, and corrigendum (bug-fix) versions are specified using integers, separated by periods.

A *compatible revision* of the SMIS does not change the meaning of any name or term used in the previous version of the SMIS, including in all text, XML, and other documents which are part of the multi-part SMIS.

- Where an XML encoding is used, "compatibility" is evaluated at the XML instance document level.
- A new version of the SMIS schema will be deemed to be "backward compatible" if all instance documents that were valid according to a previous SMIS version are valid according to the new SMIS version.

A **major** revision need not be backward compatible with previous major versions of the SMIS.

- A major revision of the SMIS schema may use XML components from previous versions.
- The initial version of a major revision has minor version=0 and corrigendum version=0.

A **minor** revision is backward compatible with previous SMIS versions with the same major version designation.

- A minor revision of the SMIS schema shall incorporate all XML components from previous minor revisions of the same major SMIS version, using their original namespace.
- A minor revision may add new XML components.

A **corrigendum** is used to correct errors in previous SMIS versions with the same major.minor version designation.

- A corrigendum version of the SMIS schema should not add new XML attributes or elements.

The SMIS schema XML attribute *version* shall always use the complete **Major.Minor.Corrigendum** number. This restriction is efficiently specified by the XML Schema pattern "[\d]+[.][\d]+[.][\d]+".

5.4 *SMIS Resources*

The SMIS is one of a growing family of I&E community geospatial standards, specifications, schemas, and related documents that constitute the Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE). The SDSFIE governance namespace in the DSE provides a configuration-controlled copy of these geospatial documents.

The DISDI namespace is governed under the DODENT (DoD Enterprise) governance namespace. Access to the content of the DISDI governance namespace through the DSE web-browser interface is through the path:

Governance Namespaces → DODENT → DISDI

Content published in the DISDI governance namespace can be accessed through the DSE using the base Uniform Resource Locator (URL):

http://metadata.ces.mil/dse/ns/DISDI[11]

DSE-hosted information resources associated with the SMIS (including the SDSFIE-M conceptual schema document and the SMIS technical specification) are accessed at:

http://metadata.ces.mil/dse/ns/DISDI/smis

Information resources associated with this SMIS version are accessible relative to:

http://metadata.ces.mil/dse/ns/DISDI/smis/1.0.2

This standard document is also accessible as an DSE-hosted information resource at:

http://metadata.ces.mil/dse/ns/DISDI/smis/1.0.2/doc

The SMIS XML schema (see Section 5.9) is accessible as an DSE-hosted information resource at three URLs:

http://metadata.ces.mil/dse/ns/DISDI/smis/1.0.2

http://metadata.ces.mil/dse/ns/DISDI/smis/1.0.2/smis

http://metadata.ces.mil/dse/ns/DISDI/smis/1.0.2/smis.xsd

The *imports* of authoritative SMIS XML schema are always configured to make maximum use of other DSE-hosted information resources.

5.5 *Referencing the SMIS*

XML schemas developed for general use within the I&E community or for a specific community of interest are able to include or import (as appropriate) schemas directly from DSE-hosted information resources. Figure 1 illustrates how the schema location for the SMIS schema is identified in an XSD, using DSE-based resource. Note that the XML namespace URI is always "**http://metadata.ces.mil/dse/ns/DISDI/sdsfie**".

Figure 1 – Imports of the SMIS Schema

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:sdsfie="http://metadata.ces.mil/dse/ns/DISDI/sdsfie"
  xmlns:ns="http://www.myresource.org/"
  targetNamespace="http://www.myresource.org/">

  <!-- - - - - - -  DSE-based Resource   - - - - - - - - - -
  <xs:import namespace="http://metadata.ces.mil/dse/ns/DISDI/sdsfie"
         schemaLocation="http://metadata.ces.mil/dse/ns/DISDI/smis/1.0.2/smis.xsd"/>
   - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -->

  <!-- ... elements omitted from this illustration -->
</xs:schema>
```

[11] Note this is an active resource corresponding to a Technical Note describing the structure and content of the DISDI governance namespace in the DSE.

In an instance document based on a schema that has been registered (hosted) in the DISDI governance namespace, the schema location in the XML instance document can reference either a DSE-based or local resource corresponding to that schema. Figure 2 illustrates how an XML instance document conforming to the SMIS would reference the DSE-based resource for the SMIS schema[12] using `xsi:schemaLocation`. Figure 3 illustrates how an XML instance document conforming to the SMIS would reference the DSE-based resource for the SMIS schema using `xsi:noNamespaceSchemaLocation`.

Figure 2 – Example *xsi:schemaLocation* usage of the DISDI-registered SMIS Schema

```
<?xml version="1.0" encoding="UTF-8"?>

< sdsfie:MD_Metadata xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance“
   xmlns:sdsfie="http://metadata.ces.mil/dse/ns/DISDI/sdsfie"
   xmlns:gmd="http://www.isotc211.org/2005/gmd"
   xmlns:gmi=“http://www.isotc211.org/2005/gmi“
   xmlns:gco="http://www.isotc211.org/2005/gco"
   xmlns:gsr="http://www.isotc211.org/2005/gsr"
   xmlns:gss="http://www.isotc211.org/2005/gss"
   xmlns:gts="http://www.isotc211.org/2005/gts"
   xmlns:gml="http://www.opengis.net/gml/3.2"
   xmlns:ism="urn:us:gov:ic:ism"
   xmlns:ntk="urn:us:gov:ic:ntk"
   xmlns:iccve="urn:us:gov:ic:ism-cvenum"
   xmlns:common="urn:us:gov:ic:common"
   xmlns:xlink="http://www.w3.org/1999/xlink"
   xsi:schemaLocation="http://metadata.ces.mil/dse/ns/DISDI/sdsfie
http://metadata.ces.mil/dse/ns/DISDI/smis/1.0.2/smis.xsd"
   ism:DESVersion="9"
   ntk:DESVersion="7"
   ism:resourceElement="true"
   ism:createDate="2014-05-16"
   ism:classification="U"
   ism:ownerProducer="USA" >


  <! -- ... elements omitted from this illustration -->

</sdsfie:MD_Metadata>
```

For a local resource, the URL of the XML schema definition document would be revised to (e.g.) “./smis.xsd”.

Figure 3 – Example *xsi:noNamespaceSchemaLocation* usage of the DISDI-registered SMIS Schema

```
<?xml version="1.0" encoding="UTF-8"?>

< sdsfie:MD_Metadata xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance“
   xmlns:sdsfie="http://metadata.ces.mil/dse/ns/DISDI/sdsfie"
   xmlns:gmd="http://www.isotc211.org/2005/gmd"
   xmlns:gmi=“http://www.isotc211.org/2005/gmi“
   xmlns:gco="http://www.isotc211.org/2005/gco"
   xmlns:gsr="http://www.isotc211.org/2005/gsr"
   xmlns:gss="http://www.isotc211.org/2005/gss"
   xmlns:gts="http://www.isotc211.org/2005/gts"
   xmlns:gml="http://www.opengis.net/gml/3.2"
   xmlns:ism="urn:us:gov:ic:ism"
```

[12] The `xsi:schemaLocation` attribute value is composed of two strings. The first string in the example (*http://metadata.ces.mil/dse/ns/DISDI/sdsfie*) is the XML namespace. The second string (*http://metadata.ces.mil/dse/ns/DISDI/smis/1.0.2/smis.xsd*) is the URL of the XML schema definition document that may be used to validate the instance document. The two strings are space-separated.

```
   xmlns:ntk="urn:us:gov:ic:ntk"
   xmlns:iccve="urn:us:gov:ic:ism-cvenum"
   xmlns:common="urn:us:gov:ic:common"
   xmlns:xlink="http://www.w3.org/1999/xlink"
   xsi:noNamespaceSchemaLocation="http://metadata.ces.mil/dse/ns/DISDI/smis/1.0.2/smis.xsd"
   ism:DESVersion="9"
   ntk:DESVersion="7"
   ism:resourceElement="true"
   ism:createDate="2014-05-16"
   ism:classification="U"
   ism:ownerProducer="USA" >

  <! -- ... elements omitted from this illustration -->

</sdsfie:MD_Metadata>
```

5.6 *SMIS XML Schema Organization*

The SMIS application schema is specified as a UML-based logical model, SDSFIE-M. This XML-based SMIS encoding profiles the existing ISO/TS 19139 XML Schema Definition (XSD) files by:

- Removing optional XML elements excluded from SDSFIE-M,
- Restricting the cardinality of XML elements required by SDSFIE-M,
- Restricting the domain of values of some XML elements as required by SDSFIE-M, and
- Adding XML components (*e.g.*, from DES.ISM.XML) not included in ISO/TS 19139.

The result is a complete and self-contained set of namespace-organized files, organized into three groups.

The first group consists of external schemas provided for convenience during system development. Formal validation should always be based on the DSE-provisioned resources for the corresponding namespaces.

- (folder) **iso** – The imported ISO/TS 19139 components for namespaces '**gco**', '**gmd**'[13], '**gmi**', '**gsr**', '**gss**' and '**gts**'; these are located in subfolder *iso*/*19139/20070417*, consistent with their equivalent DSE-hosted resources.
- (folder) ogc – The imported ISO 19136 components for namespace 'gml', located in subfolder ogc/gml/3.2.1, consistent with their equivalent DSE-hosted resources; these are imported by ISO/TS 19139.
- (folder) w3 – The imported XLink Version 1.0 components for namespace 'xlink', located in subfolder w3/1999/xlink, consistent with their equivalent DSE-hosted resources; these are imported by ISO 19136.

The second group consists of external schemas that do not currently exist as DSE-provisioned resources. They are provided for convenience during system development. Formal validation

[13] Note the *smisGmdProfile.xsd* is imported indirectly through the stub *iso/19139/TS_2007/gmd/gmd.xsd* file. This stub file simply includes the *smisGmdProfile.xsd*. This use of indirection allows other references to the ISO/TS 19139 XML schemas to remain unchanged, except for the file path to the *iso/19139/TS_2007/gmd/gmd.xsd* file itself. Organizing the directories of the SMIS local build environment in this manner allows the stub directory to be replaced with the normative ISO/TS 19139 XML schema files without affecting the other XSDs in this distribution. This allows the SMIS to be used in a local build environment where more than the minimum SMIS-profiled ISO/TS 19139 XML schema definitions are required.

should always be based on the schema specification as published by the applicable authority (*e.g.*, the DES.ISM.XML.V9 as distributed by the IC CIO).

- (folder) **ic** – Intelligence Community Data Encoding Standards as publically released by the IC CIO at (*e.g.*):

  http://www.dni.gov/index.php/about/organization/chief-information-officer/information-security-marking-metadata

  http://www.dni.gov/index.php/about/organization/chief-information-officer/need-to-know-metadata

  1. The imported DES.ISM.XML schema components, consisting of IC-ISM.xsd, CVEGeneratedTypes.xsd and the contents of the subfolder CVEGenerated. Multiple ISM versions are supported in corresponding folders (4.0.0, 5.0.0, 6.0.0, 7.0.0, 8.0.0, and 9.0.0); there are minor differences among these ISM versions in file inclusion and naming. The DES.ISM.XML is further described in Section 7.

     Note: The supplied files are those which are publicly released by the IC CIO. Full compliance to the DES.ISM.XML.V9 (and other versions) may be achieved by replacing the schema files packaged with the XML encoding of the SMIS with those distributed by the IC CIO on Intelink at: https://www.intelink.gov/sites/odni/cio/ea/library/data specifications/ism/

  2. The imported DES.NTK.XML schema components, consisting of IC-NTK.xsd. Multiple NTK versions are supported in corresponding folders (4.0.0, 5.0.0, 6.0.0, and 7.0.0); there are minor differences among these ISM versions in file inclusion and naming. The DES.NTK.XML is further described in Section 7.

     Note: The supplied files are those which are publicly released by the IC CIO. Full compliance to the DES.NTK.XML.V7 (and other versions) may be achieved by replacing the schema files packaged with the XML encoding of the SMIS with those distributed by the IC CIO on Intelink at: https://www.intelink.gov/sites/odni/cio/ea/library/data specifications/ntk/

The third group consists of the schemas that constitute the SMIS, associated example XML instances, and related documentation. These are only provided for convenience during system development. Formal validation should always be based on the DSE-provisioned resources for the SMIS.

- (top-level folder) – The seven core SMIS files:

  1. *smisGmdProfile.xsd* – a conformant subset of the '**gmd**' namespace established by ISO/TS 19139 that excludes XML components unused by the SMIS, as well as restricts cardinalities and value domains as required by the SMIS. XML instance documents that conform to this '**gmd**' profile will also conform to the full ISO/TS 19139 schema. The process by which *smisGmdProfile.xsd* was prepared is described in Annex C.

  2. *smisGmiProfile.xsd* – a conformant subset of the '**gmi**' namespace established by ISO/TS 19139-2 that excludes XML components unused by the SMIS, as well as restricts cardinalities and value domains as required by the SMIS. XML instance documents that conform to this '**gmi**' profile will also conform to the full ISO/TS 19139-2 schema. The process by which *smisGmiProfile.xsd* was prepared is described in Annex C.

  3. *smisGmdProfileExclude.sch* – a set of Schematron assertions (see Annex B.4) that are used to test instance documents for the presence of excluded XML elements.

4. *smisGmdProfileRestrict.sch* – a set of Schematron assertions used to test instance documents for the presence of inappropriate XML element cardinality, the use of non-conforming data types that violate required restrictions on value domains, the correct use of authoritative namespaces for code lists and other constraints that cannot be enforced using XML Schema (XSD).
5. *smis.xsd* – a schema file that *imports* five schemas, and then defines the additional encoding schema components required uniquely for the SMIS. The five schemas imported are:
    - *smisGmdProfile.xsd* – a conformant subset of the '**gmd**' (ISO19115) namespace in ISO/TS 19139.
    - *smisGmiProfile.xsd* – a conformant subset of the '**gmi**' (ISO19115-2) namespace in ISO/TS 19139-2.
    - *iso/19139/20070417/gco/gco.xsd* – the '**gco**' (ISO/TS 19103) namespace in ISO/TS 19139.
    - *iso/19139/20070417/gss/gss.xsd* – the '**gss**' (ISO 19107) namespace in ISO/TS 19139.
    - *iso/19139/20070417/gts/gts.xsd* – the '**gts**' (ISO 19107) namespace in ISO/TS 19139.

    In addition, the file *icDESInclude.xsd* is *included* in order to select the appropriate schema versions for the '**ism**' and '**ntk**' namespaces and then define any necessary associated XML components in order to employ different schema versions for these XML namespaces consistently with the SMIS.
6. *icDESInclude.xsd* – the schema file that imports the applicable versions of the schemas for the '**ism**' and '**ntk**' namespaces. It must be manually edited to specify the version of ISM and NTK to be used in data validation. The standard configuration imports schemas for DES.ISM.XML.V9 and DES.NTK.XML.V7. The allowed configurations are[14]:
    - ISM V9 with NTK V7 (standard configuration in accordance with SDSFIE-M)
7. *smisGmd.sch* – a set of Schematron assertions (see Annex B.4) that are used to test instance documents based on constraints specified by ISO/TS 19139 that cannot be enforced using XSD.
8. *smis.sch* – a set of Schematron assertions used to test instance documents for the correct use of authoritative namespaces for code lists, restricted uses of the *CharacterString* data type and other content constraints that cannot be enforced using XSD.

The following sections of this standard specify the structure and content of the files contained in the top-level folder.

> **Note**: Folder structure and path-naming in the self-contained local development environment are analogous to the structure and content of the DSE-provisioned resources for the SMIS. Schema files published as DSE-provisioned resources configured to reference (and validate against) only

[14] Although only one configuration is currently allowed, it is expected that updates to IC ISM may be incorporated in the future.

other DSE-provisioned resources, therefore there are small differences in include statements between same-named files.

5.7 *ISO/TS 19139 Restriction Profile*

5.7.1 Introduction

Many XML development tools can use XSD files to automate the development of interfaces and applications in a web services environment. In such an environment, it may be advantageous to limit XSD schema definitions to just those that are mandatory or recommended portions of a larger reference schema (or schema set). Doing so eliminates the overhead of managing and processing aspects of the externally-specified encoding that are not relevant.

The resulting XSD is also easier for system developers to directly inspect and comprehend.

This XML-based encoding of the SMIS includes a subset profile of the content of the ISO/TS 19139:2007 XML schema '**gmd**' and the ISO/TS 19139-2:2012 XML schema '**gmi**' namespaces that:

1. Removes XML elements that are optional in ISO/TS 19139 and 19139-2 (*i.e.*, the *minOccurs* facet value is zero) and that are excluded by SDSFIE-M.
2. Restricts the cardinality of XML elements required by SDSFIE-M. The usage of some metadata elements is altered to make elements mandatory that are optional in ISO 19115 and 19115-2. These changes to the application schema (SDSFIE-M) are carried through to the XSD encoding schema by changing the *minOccurs* or *maxOccurs* values for some of the metadata elements to allow the XML encoding schema to be used to enforce these profile-specific cardinality revisions.[15]
3. Changes the data type of some XML elements where the SMIS has restricted the domain of values. This ensures consistent encoding is used when the metadata is instantiated. The XML element definition in the XSD encoding schema corresponding to the ISO/TS 19139 element that is so restricted is appropriately revised.

The results of this transformation are the XML schema definition files *smisGmdProfile.xsd* and *smisGmiProfile.xsd*.

The file *smisGmdProfile.xsd* is an ISO 19106 *Geographic information – Profiles* Class 1 profile of ISO/TS 19139 as it is a pure subset of the ISO/TS 19139:2007 XML schema. An XML instance document that is valid with respect to *smisGmdProfile.xsd* will also be valid with respect to the full ISO/TS 19139:2007 XML schema.

The file *smisGmiProfile.xsd* is an ISO 19106 *Geographic information – Profiles* Class 1 profile of ISO/TS 19139 as it is a pure subset of the ISO/TS 19139-2:2012 XML schema. An XML instance document that is valid with respect to *smisGmiProfile.xsd* will also be valid with respect to the full ISO/TS 19139-2:2012 XML schema.

The process by which the base ISO/TS 19139 XML schema content model is revised in order to create *smisGmdProfile.xsd* and *smisGmiProfile.xsd* is described in Annex C.3.

5.7.2 Profiled XSD

The profiling restrictions applied to the ISO/TS 19139 content model are specified in Table 4. The **ISO/TS 19139 Content Model** column identifies the ISO/TS 19139 type definition that was

[15] A future version of this profile will additionally specify the use of Schematron (ISO/IEC 19757-3:2006) assertions to enforce other types of constraints.

profiled. The **XML Element** column lists the modified sub-element within the content model. The **Change Description** column indicates the change made (to either the *minOccurs*, *maxOccurs* or *type* attribute of the element).

Table 4 – SMIS-required ISO/TS 19139 Content Model Restrictions

ISO/TS 19139 Content Model[16]	XML Element	Change description
*Abstract*MD_Identification_Type[17]	pointOfContact	Attribute minOccurs changed from 0 to 1
	descriptiveKeywords	Attribute minOccurs changed from 0 to 1
	resourceConstraints	Attribute minOccurs changed from 0 to 2
	status	Attribute minOccurs changed from 0 to 1
DQ_Scope_Type	levelDescription	Attribute minOccurs changed from 0 to 1
		Attribute maxOccurs changed from unbounded to 1
EX_BoundingPolygon_Type	polygon	Changed type from gss:GM_Object_PropertyType to gml:Polygon property type (using ISO/TS 19139 encoding rules)
EX_TemporalExtent_Type	extent	Changed type from gts:TM_Primitive_PropertyType to choice of gml:TimePeriod or gml:TimeInstant property type (using ISO/TS 19139 encoding rules)
MD_DataIdentification_Type	characterSet	Attribute minOccurs changed from 0 to 1
	environmentDescription	Attribute maxOccurs changed from unbounded to 1
MD_Keywords_Type	thesaurusName	Attribute minOccurs changed from 0 to 1
MD_Metadata_Type	hierarchyLevel	Attribute minOccurs changed from 0 to 1
		Attribute maxOccurs changed from unbounded to 1
	hierarchyLevelName	Attribute minOccurs changed from 0 to 1
		Attribute maxOccurs changed from unbounded to 1
	metadataStandardName	Attribute minOccurs changed from 0 to 1
	metadataStandardVersion	Attribute minOccurs changed from 0 to 1
	locale	Attribute maxOccurs changed from unbounded to 1
	metadataConstraints	Attribute minOccurs changed from 0 to 2
	fileIdentifier	Attribute minOccurs changed from 0 to 1
	language	Attribute minOccurs changed from 0 to 1
	characterSet	Attribute minOccurs changed from 0 to 1
	parentIdentifier	Attribute minOccurs changed from 0 to 1
MD_SecurityConstraints_Type	classificationSystem	Attribute minOccurs changed from 0 to 1
PT_Locale_Type	country	Attribute minOccurs changed from 0 to 1
RS_Identifier_Type	codeSpace	Attribute minOccurs changed from 0 to 1
MD_ReferenceSystem_Type	referenceSystemIdentifier	Attribute minOccurs changed from 0 to 1
MD_Identifier_Type	authority	Attribute minOccurs changed from 0 to 1
EX_TemporalExtent_Type	extent	Changed type from gts:TM_Primitive_PropertyType to choice of gml:TimePeriod or gml:TimeInstant property type (using ISO/TS 19139 encoding rules)
EX_BoundingPolygon_Type	polygon	Changed type from gss:GM_Object_PropertyType to gml:Polygon property type (using ISO/TS 19139 encoding rules)
CI_Citation_Type	citedResponsibleParty	Attribute minOccurs changed from 0 to 1
MD_GridSpatialRepresentation_Type	axisDimensionProperties	Attribute minOccurs changed from 0 to 1
		Attribute maxOccurs changed from unbounded to 1

[16] The naming convention used by ISO/TS 19139 in transforming a UML class to an XSD complex type is to re-use the class name as the complex type appended with "_Type".

[17] The transformation for UML classes that have the *Abstract* property set to *true* is the same as for non-abstract classes with the addition of the pre-pended string "Abstract" added to the name of the resulting complex type. The pre-pended substring is presented here in *italics* merely to emphasize the resulting naming of the XSD complex type.

ISO/TS 19139 Content Model[16]	XML Element	Change description
MD_Georectified_Type	cornerPoints	Attribute minOccurs changed from 0 to 2
		Attribute maxOccurs changed from unbounded to 4

The resulting *smisGmdProfile.xsd* schema depends only on locally-provided schemas as documented in Figure 4.

Figure 4 – Imports of smisGmdProfile.xsd

```
<!-- --------- GMD Subset Resources ---------->
 <xs:import namespace="http://www.isotc211.org/2005/gco"
                                    schemaLocation="../iso/19139/20070417/gco/gco.xsd"/>
 <xs:import namespace="http://www.isotc211.org/2005/gsr"
                                    schemaLocation="../iso/19139/20070417/gsr/gsr.xsd"/>
 <xs:import namespace="http://www.isotc211.org/2005/gss"
                                    schemaLocation="../iso/19139/20070417/gss/gss.xsd"/>

<!-- ---------- GML 3.2.1 Resources ---------->
 <xs:import namespace="http://www.opengis.net/gml/3.2"
                                    schemaLocation="../ogc/gml/3.2.1/gml.xsd"/>
```

The process by which *smisGmdProfile.xsd* was prepared ensures it excludes XML components unused by the SMIS, as well as restricts cardinalities and value domains as required by the SDSFIE-M and specified in Table 4. It may therefore be used as one component of an XSD-based SMIS instance document conformance test.

In general, the use of *smisGmdProfile.xsd* is intended only to assist in system development. Instead, XML instance documents should be validated against the complete DSE-based ISO/TS 19139 schemas, as documented by the *imports* in Figure 5, followed by evaluation of the Schematron constraints specified by *smisGmdProfileExclude.sch* and *smisGmdProfileRestrict.sch*.

Figure 5 – Imports of smis.xsd

```
<!-- --------- DSE-based  Resources ---------->
 <xs:import namespace="http://www.isotc211.org/2005/gco"

schemaLocation="http://metadata.ces.mil/dse/ns/DISDI/smis/1.0.2/iso/19139/20070417/gmd/gmd.xsd"/>
 <xs:import namespace="http://www.isotc211.org/2005/gsr"

schemaLocation="http://metadata.ces.mil/dse/ns/DISDI/smis/1.0.2/iso/19139/20070417/gsr/gsr.xsd"/>
 <xs:import namespace="http://www.isotc211.org/2005/gss"

schemaLocation="http://metadata.ces.mil/dse/ns/DISDI/smis/1.0.2/iso/19139/20070417/gss/gss.xsd"/>
```

Notice in this version of SMIS all of the profiled elements in Table 4 relate to the '**gmd**' namespace and ***none*** apply to the '**gmi**' namespace and, therefore, there are, currently, no type or cardinality changes found in *smisGmiProfile.xsd*.

5.7.3 Schematron Constraints

ISO/IEC 19757-3:2006 defines the Schematron Document Schema Definition Language (DSDL) that may be used to specify one or more validation processes to be performed against XML instance documents (see Annex B.4).

The set of assertions specified by *smis.sch* test for the restriction of:

- Content based on constraints specified by ISO/TS 19139 that cannot be enforced using XSD.

The set of assertions specified by *smisGmdProfileExclude.sch* test for the exclusion of:

- XML components optional in ISO/TS 19139 (*i.e.*, the *minOccurs* facet value is zero) and are excluded by the SMIS (in effect the *maxOccurs* facet value would be zero), *e.g.*, nas:MD_Metadata/gmd:dataSetURI are not allowed in valid SMIS instance documents.

The set of assertions specified by *smisGmdProfileRestrict.sch* test for the restriction of:

- Cardinalities as specified in Table 4, equivalent to either increasing the value of the *minOccurs* facet from zero to one or decreasing the value of the *maxOccurs* facet from unbounded to a smaller fixed number, such as one.
- Value domains as specified in Table 4 and Table 7, *e.g.*, requiring that the values of sdsfie:MD_Metadata/gmd:hierarchyLevel be only those established by the code list "**http://metadata.ces.mil/dse/ns/DISDI/codelist/ScopeAmplicationCode**".[18]
- Code lists to those defined by DSE-based authoritative namespaces as specified in Table 11 and Annex B.2.4.

The *smis.sch*, *smisGmdProfileExclude.sch* and *smisGmdProfileRestrict.sch* files may therefore be used in conjunction with an XSD-based SMIS instance document structural conformance test. Annex A specifies such a conformance test.

5.8 *Extension Requirements*

5.8.1 Overview

In addition to profiling the base ISO/TS 19139 schema, an XML schema conformant to the SMIS is required to include extensions to that base schema. These extensions reuse (extend) the ISO/TS 19139 XML content model as documented in the application schema specified in SDSFIE-M: Conceptual Model.

While the XML schema definitions of ISO/TS 19139 may be modified in order to restrict the content of a metadata instance document (effectively permitting only a subset of the potential content of an ISO/TS 19139-conformant instance document), altering the names of existing elements or altering the semantics of elements in the ISO/TS 19139 namespace is prohibited.

5.8.2 Element Extension

Due to the requirements of the SDSFIE-M, some additional encoding schema elements are required above and beyond those defined in the ISO/TS 19139 XML schema. Extended elements are created using the XML schema *extension* mechanism to create new XML element and type definitions based on type definitions in ISO/TS 19139. These extended elements are

[18] Note URLs for codelist resources continue to reference the 'dse' rather than 'dse' – which is used only in establishing XML namespaces and DSE-hosted schemas and schema-related files.

substitutable within an XML instance document for the elements they have extended; they are required to provide at least the same required metadata content as the original metadata element.

The extended metadata elements for the SMIS are defined in the XML Schema *smis.xsd*, which uses the namespace ('**sdsfie**') specified in Section 5.2. The ISO/TS 19139 metadata elements, their corresponding extended elements and the rationale for their extension are listed in Table 5.

Table 5 – ISO/TS 19139 Elements Extended for the SMIS

ISO/TS 19139 Element	SMIS Extended Element	Extension Purpose
gmd:MD_Metadata	sdsfie:MD_Metadata	Add DES.ISM.XML root and resource node XML attributes Add DES.NTK.XML root node XML attribute
gmd:MD_SecurityConstraints	sdsfie:MD_SecurityConstraints	Add sdsfie:capcoMarking and nas:notices elements to integrate DES.ISM.XML Add sdsfie:needToKnow element to integrate DES.NTK.XML Add sdsfie:notices element to integrate DES.ISM.XML
gmd:MD_ApplicationSchemaInformation	sdsfie:MD_ApplicationSchemaInformation	Add sdsfieAdaptationVersion element to integrate with SDSFIE Online
gmd:MD_FeatureCatalogueDescription	sdsfie:MD_FeatureCatalogueDescription	This replaces the element of the same name from gmd:MD_FeatureCatalogueDescription, which was profiled for the purpose of integrating better with SDSFIE Online.
N/A	sdsfie:FeatureType	Added to provide the ability to describe either SDSFIE or non-SDSFIE feature types
N/A	sdsfie: Feature	Added to provide the ability to descitbe SDSFIE feature types.
(Abstract) gmd:EX_GeographicExtent	sdsfie:BoundingPoint	Add additional substitutable type to support simplified extents

The extended metadata elements listed in the right-hand column of Table 5 are substitutable for the original metadata elements listed in the left-hand column. Use of the extended elements (rather than the original ISO/TS 19139 element) is required for conformance with this profile as these extended elements were created to support the requirements of the SDSFIE-M. For example, instantiation of a valid *sdsfie:MD_ FeatureCatalogueDescription* in place of *gmd:MD_ FeatureCatalogueDescription* results in that section of the metadata being conformant with this profile and the ability to specify a *featureTypes* element for the resource that can contain the *sdsfieFeature* description for the resource.

5.8.3 Pattern-restricted Domain

The SMIS limits the value domain of several ISO 19115 metadata properties that use the *CharacterString* data type to either follow a restricted pattern or contain only a specific set of members.

In the case of a restricted pattern, an instance document conformant with this profile will be populated with values that satisfy the restriction imposed by the specified pattern. The ISO/TS 19139 object properties instantiated in this profile using a pattern are identified in Table 6 where the pattern-restricted string from this profile to be used in an instantiation is listed in the right-hand column.

Table 6 – ISO/TS 19139 CharacterString Properties instantiated using a Pattern-restriction

ISO/TS 19139 Object	Object Property	SMIS Pattern-restricted String
gmd:MD_Metadata	gmd:metadataStandardVersion	sdsfie:MetadataStandardVersion
gmd:MD_SecurityConstraints	gmd:classificationSystem	sdsife:ClassificationSystem
gmd:CI_Telephone	gmd:voice	sdsfie:TelephoneNumber
gmd:CI_Telephone	gmd:facsimile	sdsfie:TelephoneNumber

In an instance document, the specified pattern-restricted *xs:string* is used in place of *gco:CharacterString* to populate the property.

5.8.4 Codelist-restricted Domain

In the case of a specific set of members, an instance document conformant with this profile will be populated with values defined in an identified code list. The ISO/TS 19139 object properties instantiated in this profile through a code list are identified in Table 7 where the code list from this profile that is to be used in an instantiation is listed in the right-hand column.

Table 7 – ISO/TS 19139 CharacterString Properties instantiated using a Code List

ISO/TS 19139 Object	Object Property	SMIS Code List
gmd:MD_Metadata	gmd:hierarchyLevelName	sdsfie:ScopeAmplificationCode
gmd:MD_Metadata	gmd:metadataStandardName	sdsfie:MetadataStandardNameCode
gmd:MD_ScopeDescription	gmd:other	sdsfie:ScopeAmplificationCode

In an instance document, the specified code list is used in place of *gco:CharacterString* to populate the property with a value from that code list. This mechanism is described further in Section 6.1.

5.9 *ISO/TS 19139 Extension Profile*

5.9.1 Introduction

The SMIS ISO/TS 19139 Extension Profile consists of three files:

- the XML Schema *smis.xsd*,
- the XML Schema *icDESInclude.xsd*, and
- a set of Schematron assertions (see Annex B.4) specified by *smis.sch*.

5.9.2 *smis.xsd*

The XML Schema *smis.xsd* imports:

- The '**gmd**' (ISO19115) namespace components from ISO/TS 19139, as either:
  - DSE-resource: "**http://metadata.ces.mil/dse/ns/DISDI/smis/1.0.2/iso/19139/20070417/gmd/gmd.xsd"**
  - Local resource: *smisGmdProfile.xsd* – a conformant subset of the '**gmd**' components described in Section 5.7.
  - Local resource: *smisGmiProfile.xsd* – a conformant subset of the '**gmi**' components described in Section 5.7.
- The '**gco**' (ISO/TS 19103) namespace components from ISO/TS 19139, as either:
  - DSE-resource: "**http://metadata.ces.mil/dse/ns/DISDI/smis/1.0.2/iso/19139/20070417/gco/gco.xsd"**

- Local resource: *iso/19139/20070417/gco/gco.xsd*.

- The '**gss**' (ISO 19107) namespace components from ISO/TS 19139, as either:
  - DSE-resource: "**http://metadata.ces.mil/dse/ns/DISDI/smis/1.0.2/iso/19139/20070417/gss/gss.xsd"**
  - Local resource: *iso/19139/20070417/gss/gss.xsd*.

A consistent choice of imports must be made; either all must be from the DSE-hosted resource set, or all must be from the local resource set.

The *smis.xsd* schema file additionally includes the encoding schema components required uniquely for the SMIS. These extensions are defined in the SDSFIE XML namespace '**sdsfie**' in compliance with the profiling rules of ISO/TS 19139.

5.9.3 *icDESInclude.xsd*

The XML Schema *icDESInclude.xsd* imports:

- The '**ism**' namespace components from DES.ISM.XML, as either:
  - DSE-resource: "**http://metadata.ces.mil/dse/ns/DISDI/smis/1.0.2/ic/ism/9.0.0/IC-ISM.xsd"**
  - Local resource: *ic/ism/9.0.0/IC-ISM.xsd* – the publically-released DES.ISM.XML.V9.
- The '**ntk**' namespace components from DES.NTK.XML, as either:
  - DSE-resource: "**http://metadata.ces.mil/dse/ns/DISDI/smis/1.0.2/ic/ntk/7.0.0/IC-NTK.xsd"**
  - Local resource: *ic/ntk/7.0.0/IC-NTK.xsd* – the publically-released DES.NTK.XML.V7.

The *icDESInclude.xsd* schema file may be edited in order to select alternative schema versions for the '**ism**' and '**ntk**' XML namespaces. The standard configuration imports schemas for DES.ISM.XML.V9 and DES.NTK.XML.V7. The allowed configurations are:

- ISM V9 with NTK V7 (standard configuration in accordance with SDSFIE-M: Conceptual Schema, Version 1.0.2)

Note: Only the use of DES.ISM.XML.V9 with DES.NTK.XML.V7 is conformant to the SMIS, Version 1.0.2 and SDSFIE-M: Conceptual Schema, Version 1.0.2. Alternative configurations, as indicated in the list above, may be adopted as a means of enabling system transition and/or interoperability with other IC systems – however these configurations are ***not*** conformant with either the SMIS, Version 1.0.2 or SDSFIE-M: Conceptual Schema, Version 1.0.2.

The *icDESInclude.xsd* schema file additionally includes the encoding schema components required uniquely for the SMIS. These extensions are defined in the SDSFIE XML namespace '**sdsfie**' in compliance with the profiling rules of ISO/TS 19139, and specify associated XML components that enable the integration of different schema versions for the '**ism**' and '**ntk**' XML namespaces with the SMIS

A consistent choice of imports must be made; either all must be from the DSE-hosted resource set, or all must be from the local resource set.

Note: The published (and locally-supplied files) for all referenced DES.ISM.XML and DES.NTK.XML schemas are those which are publicly released by the IC CIO. Full compliance to the applicable DES.ISM.XML and DES.NTK.XML version may be achieved by replacing the schema files packaged with the XML encoding of the SMIS with the corresponding FOUO files distributed by the IC CIO on Intelink at:

► https://www.intelink.gov/sites/odni/cio/ea/library/data%20specifications/ism/

► https://www.intelink.gov/sites/odni/cio/ea/library/data%20specifications/ntk/

5.9.4 *smis.sch*

The *smis.sch* Schematron file consists of a set of Schematron assertions that test for the restriction of:

- Code lists to those defined by DSE-based authoritative namespaces as specified in Table 11 and Annex B.2.4.
- Some uses of the *CharacterString* data type to those specified in Table 6 and Table 7.
- Content based on constraints that cannot be enforced using XSD.

The *smis.sch* file shall be used in conjunction with the *smis.xsd* in SMIS instance document conformance testing. This use is detailed in Annex A.

6 SMIS Encoding Principles

6.1 *Resource-based Code Lists*

In ISO 19115 some metadata elements with defined value domains are implemented as *code lists*. To support the code list construct, ISO/TS 19139 provides a mechanism for encoding values in a metadata instance using both a *code list value* and the identification of the code list in which the value is defined. The use of code lists in an XML instance document is described in Annex B.2.2.

Code lists are instantiated by identifying a resource defined externally to the metadata instance. This resource specifies a “well-known” set of values that may be referenced (and thus used) when populating a metadata instance in order to ensure a consistent metadata encoding.

Code lists whose domain members are specified using such externally-defined resources are referred to in this standard as being “resource-based”.

The advantage of the *code list* is that the domain of values is defined externally to the XML schema and can be extended without changing the XML schema – the metadata instance simply references the *code list* and one of its members.

Code list values are identified in a metadata XML instance document by a URI. In practice a URL is often used for the identifier. In the SMIS, identifiers have been defined for each of the metadata code lists. The identifiers are separated into two groups: those from “general use” publicly-available standards that have not been altered, and those specific to the I&E community.

6.1.1 Publicly Available Standards-based Code Lists

The first group of identifiers is the set of code lists derived from publicly available standards, without modification of the code list domain (no values added, subtracted or modified). These identifiers are listed in Table 8, which specifies the standard, the code list identifier and a description of the values included in the code list.

Table 8 – Code Lists Defined in the GPAS Governance Namespace

Source Standard	Code List Identifier	Value Description
ISO 639-2:1998 *Codes for the representation of names of languages – Part 2: Alpha-3 code*	**iso639-2**	3-letter language code

The base URL for these code lists is "**http://metadata.ces.mil/dse/ns/GPAS/codelist/**". The full, unambiguous code list identifier is composed by concatenating this base URL with the code list identifier listed in Table 8. Examples of the full code list URL identifier for DISDI-based code lists are:

- "http://metadata.ces.mil/dse/ns/GPAS/codelist/iso639-2"

The Geopolitical Entities, Names, and Codes (GENC) Standard, Edition 1.0, was established as the mandated country codes data standard for DoD in accordance with the Architecture and Standards Review Group (ASRG) Memorandum, dated 23 January 2013, acting under the authority of the DoD Chief Information Officer (DoD CIO).

The National Geospatial-Intelligence Agency (NGA), as the functional manager for Geospatial Intelligence (GEOINT) standards, developed the GENC Standard as the U.S. Government profile of ISO 3166-1 in consultation with the Department of State and the U.S. Board on Geographic Names (BGN). The standard and all associated implementation guidance, schemas, and managed-content, are available to all government entities and the general public through an unclassified, unrestricted web-based service hosted by NGA.The second group of code list identifiers represent the set of country code lists that fall under this directive. The GENC codes are updated regularly. These identifiers are listed in Table 8, which specifies the standard, the code list identifier and a description of the values included in the code list.

Table 9 – GENC-Based Code Lists Defined in the DISDI Governance Namespace

Source Standard	Code List Identifier	Value Description
The Geopolitical Entities, Names, and Codes (GENC) Standard specifies a profile of ISO 3166, Codes for the representation of names of countries and their subdivisions version of ISO 3166-1:2006 *Codes for the representation of names of countries and their subdivisions – Part 1: County codes*	**GENC-digraph**	2-letter country code
	GENC-trigraph	3-letter country code
The Geopolitical Entities, Names, and Codes (GENC) Standard specifies a profile of ISO 3166, Codes for the representation of names of countries and their subdivisions version of ISO 3166-2:1998 *Codes for the representation of names of countries and their subdivisions – Part 2: Country subdivision code*	**GENC-subvision**	2-letter country code, separator (hyphen), up to 3-letter alphanumeric subdivision identifier

The base URL for these code lists is "**http://metadata.ces.mil/dse/ns/DISDI/codelist/**". The full, unambiguous code list identifier is composed by concatenating this base URL with the code list identifier listed in Table 9. An example of the full code list URL identifier for DISDI-based code lists is:

- "**http://metadata.ces.mil/dse/ns/DISDI/codelist/GENC-trigraph**"

6.1.2 I&E Community-specific Code Lists

The second group of identifiers is the set of code lists created or profiled for use by the SMIS. In profiling a code list, some values (which are not to be used in metadata XML instance documents conformant to the intended profile) are deleted. In addition, new values may be added to a code list.

These identifiers are listed in Table 10, which specifies the standard, the code list identifier and a description of the values included in the code list.

Table 10 – Code Lists Defined in the DISDI Governance Namespace

Source Standard/Specification	Code List Identifier	Value Description
SDSFIE-M	**MetadataStandardNameCode**	A set of metadata standard names individually identifying the metadata standard being used to specify information about a resource.
	ScopeAmplificationCode	A set of scope amplifications individually identifying an augmentation of an identified grouping of information within a resource.
ISO 19115:2003 *Geographic information – Metadata* [as profiled in this standard]	**AssociationTypeCode**	The justification for the correlation of two datasets.
	BandDefinitionCode	The designation of criterion for defining maximum and minimum wavelengths for a spectral band.
	CellGeometryCode	A code indicating whether grid data is point, area or volume.
	CharacterSetCode	A set of character coding standards that may be individually used by the text of a resource.
	ClassificationCode	A set of security classification levels that may be individually applicable to the content of a resource.
	ContextCode	The designation of criterion for defining the context of the scanning process event.
	CouplingTypeCode	The type of coupling between service and associated data
	CoverageContentTypeCode	The specific type of information represented in the cell.
	DateTypeCode	A set of date types individually indicating the nature of the event indicated by a date.
	DCPList	The type of distributed computing platform or environment.
	DimensionNameTypeCode	The name of the dimension.
	EvaluationMethodTypeCode	The type of method for evaluating an identified data quality measure
	GeometricObjectTypeCode	A set of geometric object types individually identifying a type of vector-based object representation that is used to locate zero-, one-, two-, or three dimensional spatial locations.
	GeometryTypeCode	The geometric description of the collection
	ImagingConditionCode	A code which indicates conditions which may affect the image
	KeywordTypeCode	A set of keyword types individually indicating the method used to group a set of similar keywords.

	MaintenanceFrequencyCode	A set of maintenance frequency codes individually indicating the frequency with which modifications and deletions are made to the data after it is first produced.
	NoticeTypeCode	The set of currently authorized Notice values (IC-ISM version 9)
	ObjectiveTypeCode	The temporal persistence of collection objective
	OnlineFunctionCode	A set of online functions individually indicating a function performed by a resource.
	ParameterDirection	The indication of whether the parameter is an input to the service, an output or both
	PolarisationOrientationCode	The polarisation of the antenna relative to the waveform.
	PriorityCode	The ordered list of priorities.
	PresentationFormCode	The mode in which the resource is represented.
	ProgressCode	The status of the dataset or progress of a review.
	RestrictionCode	A set of restrictions individually identifying a limitation placed upon the access to, or use of, a resource.
	RoleCode	A set of roles individually identifying a function performed by a responsible party.
	ScopeCode	A set of scopes individually identifying a grouping of information within a resource.
	SequenceCode	The temporal relation of activation or the relative time-ordering of an event.
	SpatialRepresentationTypeCode	A set of spatial representation types individually identifying a method used to represent geospatial information in a resource.
	TopologyLevelCode	A set of topology levels individually identifying the degree of complexity of the spatial relationships among geometry objects in a resource as represented in a topology.
	TransferFunctionTypeCode	The type of transform function to be used when scaling a physical value for a given element.
	TriggerCode	The mechanism of activation of an event.

The base URL for these code lists is "**http://metadata.ces.mil/dse/ns/DISDI/codelist/**". The full, unambiguous code list identifier is composed by concatenating this base URL and the code list identifier listed in Table 10. Examples of the full code list URL identifier for DISDI-based code lists are:

- **http://metadata.ces.mil/dse/ns/GSIP/codelist/ScopeAmplificationCode**
- **http://metadata.ces.mil/ dse /ns/GSIP/codelist/RoleCode**

6.1.3 Code List Authoritative Namespaces

Table 11 lists all code lists used in the SMIS. For each code list the allowed authoritative namespace(s) are specified. Also included are example domain values.

SMIS-conformant instance documents only use a valid domain from the applicable authoritative namespace(s) for a code list. Additional domain values may be added to the currently published domains when justified by I&E business requirements.

Table 11 – SMIS Code List Authoritative Namespaces

Name / Authoritative Namespace(s)	**Example(s)** *(not all-inclusive)*
AssociationTypeCode justification for the correlation of two datasets NOTE: The allowed authoritative namespaces are: • ISO 19115:2003/Cor. 1:2006 (as extended by the North American Profile): • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist//AssociationTypeCode**"	"**crossReference**" *or* "**largerWorkCitation**" *or* "**partOfSeamlessDatabase**" etc.
BandDefinitionCode designation of criterion for defining maximum and minimum wavelengths for a spectral band NOTE: The allowed authoritative namespaces are : • ISO 19115-2:2009 (profiled): • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/BandDefinitionCode**"	"**3dB**" *or* "**halfMaximum**" *or* "**fiftyPercent**" *or* "**oneOverE**" *or* "**equivalentWidth**"
CellGeometryCode code indicating whether grid data is point, area, or volume NOTE: The allowed authoritative namespaces are: • ISO 19115:2003/Cor. 1:2006 (as extended by the North American Profile): • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist//CellGeometryCode**"	"**point**" *or* "**area**" *or* "**voxel**"
CharacterSetCode character coding standard used by the text of a resource NOTE: The allowed authoritative namespaces are: • ISO 19115:2003/Cor. 1:2006 (profiled): • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/CharacterSetCode**"	"**utf8**" etc.
ClassifiedCode a code indicating whether a resource is classified or not. NOTE: The allowed authoritative namespaces are: • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/ClassifiedCode**"	"**unclassified**" *or* "**classified**"
ClassificationCode level of classification applicable to a resource, or portion of a resource. NOTE: The allowed authoritative namespaces are: • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/ClassificationCode**"	"**U**" (Unclassified) *or* "**C**" (Confidential) *or* "**S**" (Secret) *or* "**TS**" (Top Secret) *or* "**R**" (Restricted)
ContextCode designation of criterion for defining the context of the scanning process event NOTE: The allowed authoritative namespaces are : • ISO 19115-2:2009: • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/ContextCode**"	"**acquisition**" *or* "**pass**" *or* "**wayPoint**"

Name / Authoritative Namespace(s)	**Example(s)** *(not all-inclusive)*
CountryCode recognized geographic identifier that is a member of the list of countries maintained in the GENC standard. NOTE: The allowed authoritative namespace is: • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/GENC-digraph**" "**http://metadata.ces.mil/dse/ns/DISDI/codelist/GENC-trigraph**"	"**US**" *or* "**USA**" *or* "**GB**" *or* "**GBR** etc.
CouplingTypeCode type of coupling between service and associated data. NOTE: The allowed authoritative namespaces are: • ISO/DIS 19115-1: • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/CouplingTypeCode**"	"**loose**" *or* "**mixed**" *or* "**tight**"
CoverageContentTypeCode specific type of information represented in the cell. NOTE: The allowed authoritative namespaces are: • ISO 19115:2003/Cor. 1:2006: • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/CoverageContentTypeCode**"	"**image**" *or* "**thematicClassification**" *or* "**physicalMeasurement**"
DateTypeCode context with respect to which a date is specified. NOTE: The allowed authoritative namespaces are: • ISO 19115:2003/Cor. 1:2006 (as extended by the North American Profile): • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/DateTypeCode**"	"**creation**" *or* "**publication**" *or* "**revision**" etc.
DCPList type of distributed computing platform or environment. NOTE: The allowed authoritative namespaces are: • ISO/DIS 19115-1: • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/DCPList**"	"**XML**" *or* "**CORBA**" *or* "**JAVA**"" etc.
DimensionNameTypeCode name of the dimension. NOTE: The allowed authoritative namespaces are: • ISO 19115-2:2009: • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/DimensionNameTypeCode**"	"**row**" *or* "**column**" *or* "**vertical**" etc.
EvaluationMethodTypeCode type of method for evaluating an identified data quality measure. NOTE: The allowed authoritative namespaces are: • ISO 19115:2003/Cor. 1:2006 (as extended by the North American Profile) • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/EvaluationMethodTypeCode**"	"**directInternal**" *or* "**directExternal**" *or* "**indirect**"

Name / Authoritative Namespace(s)	**Example(s)** *(not all-inclusive)*
GeometricObjectTypeCode name of point or vector objects used to locate zero-, one-, two-, or three-dimensional spatial locations in the dataset. NOTE: The allowed authoritative namespaces are: • ISO 19115:2003/Cor. 1:2006: • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/GeometricObjectTypeCode**"	"**complex**" *or* "**composite**" *or* "**curve**" etc.
GeometryTypeCode geometric description of the collection NOTE: The allowed authoritative namespaces are : • • ISO 19115-2:2009: • DISDI "**http://metadata.ces.mil/dse/ns/DISDI/codelist/GeometryTypeCode**"	"**point**" *or* "**linear**" *or* "**areal**" etc.
ImagingConditionCode code which indicates conditions which may affect the image. NOTE: The allowed authoritative namespaces are: • ISO 19115:2003/Cor. 1:2006: • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/ImagingConditionCode**"	"**blurredImage**" *or* "**cloud**" *or* "**degradingObliquity**" etc.
KeywordTypeCode method used to group a set of similar keywords. NOTE: The allowed authoritative namespaces are: • ISO 19115:2003/Cor. 1:2006 (as extended by the North American Profile) • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/KeywordTypeCode**"	"**discipline**" *or* "**place**" *or* "**stratum**" etc.
MaintenanceFrequencyCode frequency with which modifications and deletions are made to the data after it is first produced. NOTE: The allowed authoritative namespaces are: • ISO 19115:2003/Cor. 1:2006 (as extended by the North American Profile): • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/MaintenanceFrequencyCode**"	**"continual"** *or* **"daily"** *or* **"weekly"** etc.
MetadataStandardNameCode name of the metadata standard used. NOTE: The allowed authoritative namespaces are: • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/MetadataStandardNameCode**"	"**sdsfieMetadata**"
NoticeTypeCode set of currently authorized Notice values NOTE: The allowed authoritative namespacs are:: • ISM: **"urn:us:gov:ic:ism-cvenum"** Found in the schema file: ./ic/ism/*version*/CVEGenerated/CVEnumISMNotice.xml Where *version* is the version of IC-ISM used (currently this is "9.0.0"). • DISDI (for the currently mandated version of ISM): "**http://metadata.ces.mil/dse/ns/DISDI/codelist/NoticeTypeCode**	"**RD**" *or* "**IMCON**" *or* "**FRD**" etc.

Name / Authoritative Namespace(s)	**Example(s)** *(not all-inclusive)*
ObjectiveTypeCode temporal persistence of collection objective NOTE: The allowed authoritative namespaces are : • ISO 19115-2:2009: • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/ObjectiveTypeCode**"	"**instantaneousCollection**" *or* "**persistentView**" *or* "**survey**"
OnlineFunctionCode function performed by the resource. NOTE: The allowed authoritative namespaces are: • ISO 19115:2003/Cor. 1:2006 (as extended by the North American Profile): • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/OnlineFunctionCode**"	"**download**" *or* "**information**" *or* "**offlineAccess**" etc.
ParameterDirection indication if the parameter is an input to the service, an output or both. NOTE: The allowed authoritative namespaces are: • ISO/DIS 19115-1: • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/ParameterDirection**"	"**in**" *or* "**out**" *or* "**inOut**"
PolarisationOrientationCode polarisation of the antenna relative to the waveform NOTE: The allowed authoritative namespaces are : • ISO 19115-2:2009 (profiled): • DISDI "**http://metadata.ces.mil/dse/ns/DISDI/codelist/PolarisationOrientationCode**"	"**horizontal**" *or* "**vertical**" *or* "**leftCircular**" etc.
PriorityCode ordered list of priorities NOTE: The allowed authoritative namespaces are : • • ISO 19115-2:2009 (profiled): • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/PriorityCode**"	"**critical**" *or* "**highImportance**" *or* "**mediumImportance**" etc.
PresentationFormCode mode in which the data is represented NOTE: The allowed authoritative namespaces are : • ISO 19115:2003/Cor. 1:2006 (as extended by the North American Profile) • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/PresentationFormCode**"	"**documentDigital"** *or* **"documentHardcopy"** *or* **"imageDigital"** etc.
ProgressCode status of the dataset or progress of a review NOTE: The allowed authoritative namespaces are: • ISO 19115:2003/Cor. 1:2006 (as extended by the North American Profile) • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/ProgressCode**"	"**completed**" *or* "**historicalArchive**" *or* "**obsolete**" etc.

Name / Authoritative Namespace(s)	**Example(s)** *(not all-inclusive)*
RestrictionCode limitation placed upon the access to, or use of, a resource. NOTE: The allowed authoritative namespaces are: • ISO 19115:2003/Cor. 1:2006 (profiled) • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/RestrictionCode**"	"**copyright**" *or* "**intellectualPropertyRights**" *or* "**restricted**" etc.
RoleCode function performed by a responsible party for a resource. NOTE: The allowed authoritative namespaces are: • ISO 19115:2003/Cor. 1:2006 (as extended by the North American Profile) • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/RoleCode**"	"**resourceProvider**" *or* "**custodian**" *or* "**owner**" etc.
ScopeCode class of information to which the referencing entity applies. NOTE: The allowed authoritative namespaces are: • ISO 19115:2003/Cor. 1:2006 (profiled): • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/ScopeCode**"	"**dataset**" *or* **"series"** *or* **"feature"** etc.
ScopeAmplificationCode A set of scope amplifications individually identifying an augmentation of an identified grouping of information within a resource. NOTE: The allowed authoritative namespaces are : • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/ScopeAmplificationCode**"	"**cell**" *or* "**theme**" *or* "**notApplicable**" etc.
SequenceCode temporal relation of activation NOTE: The allowed authoritative namespaces are : • ISO 19115-2:2009: • DISDI "**http://metadata.ces.mil/dse/ns/DISDI/codelist/SequenceCode**"	"**start**" *or* "**end**" *or* "**instantaneous**"
SpatialRepresentationTypeCode method used to represent geospatial information in a resource. NOTE: The allowed authoritative namespaces are: • ISO 19115:2003/Cor. 1:2006 (as extended by the North American Profile) • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/SpatialRepresentationTypeCode**"	"**vector**" *or* "**grid**" *or* "**textTable**" etc.
TopologyLevelCode code which identifies the degree of complexity of the spatial relationships NOTE: The allowed authoritative namespaces are : • DISDI: "**http://metadata.ces.mil/dse/ns/DISDI/codelist/TopologyLevelCode**"	**"geometryOnly"** *or* **"topology1D"** *or* **"planarGraph"** etc.
TransferFunctionTypeCode transform function to be used when scaling a physical value for a given element NOTE: The allowed authoritative namespaces are : • ISO 19115-2:2009: • DISDI "**http://metadata.ces.mil/dse/ns//DISDI/codelist/TransferFunctionTypeCode**"	"**linear**" *or* "**logarithmic**" *or* "**exponential**"

Name / Authoritative Namespace(s)	Example(s) *(not all-inclusive)*
TriggerCode Mechanism of activation NOTE: The allowed authoritative namespaces are : • ISO 19115-2:2009: • DISDI "**http://metadata.ces.mil/dse/ns/DISDI/codelist/TriggerCode**"	"**automatic**" *or* "**manual**" *or* "**preProgrammed**"

6.1.4 Units of Measure as Code Lists

Code lists of mutually comparable physical quantities are distinguished from other types of code lists in the GSIP Governance Namespace. Some of these identifiers are listed in Table 12, which specifies the standard, the physical quantity identifier and a description of the values that are included in the code list.

Table 12 – Units of Measure Defined in the GSIP Governance Namespace

Source Standard	Physical Quantity Identifier	Value Description
ISO 80000 (a multi-part standard) *Quantities and units* [as profiled for use in the NSG]	**area**	Area quantities, where area is the quantity of a two dimensional (square) region that is (generally) the product of length and width; e.*g*., "squareMetre", "squareFoot".
	length	Length quantities, where length is the quantity of a linear extent; e.*g*., "metre", "foot", "fathom", "nauticalMile".
	planeAngle	Plane angle quantities, where plane angle is the quantity of an angle in two dimensions (the angle between two half-lines terminating at the same point); e.*g*., "radian", "arcDegree", "grad".
	pureNumber	Pure number quantities, where a pure number is a dimensionless quantity (a quantity with the dimension of 1); e.*g*., "unitless", "percent", "deciMachNumber".
	speed	Speed quantities, where speed is the quantity of a (directionless) rate of motion (change in position per unit time); e.*g*., "metrePerSecond", "milePerHour".
	time	Time quantities, where time is the quantity by which events are compared in position and duration; e.*g*., "second", "minute", "hour", "day".
	volume	Volume quantities, where volume is the quantity of a three dimensional (cubic) region that is (generally) the product of length, width, and height; e.*g*., "cubicMetre", "liter", "usGallon".

The base URL for these specialized code lists is "**http://metadata.ces.mil/dse/ns/GSIP/uom/**". The full, unambiguous code list identifier is composed by concatenating this base URL and the code list identifier listed in Table 12. Examples of the full code list URL identifier for GSIP-based Units of Measure code lists are:

- **http://metadata.ces.mil/dse/ns/GSIP/uom/length**
- **http://metadata.ces.mil/dse/ns/GSIP/uom/time**

Table 12 is not complete; the full list of physical quantities is specified at:

- **http://metadata.ces.mil/dse/ns/GSIP/uom**

The use of code lists for units of measure is further described in Annex B.2.3.

6.2 *Coordinate Reference Systems*

6.2.1 Specification and Use

ISO 19115 specifies the ability to describe the horizontal, vertical and temporal extent of a resource. In order to unambiguously specify horizontal and vertical extent and positions it is necessary to identify the spatial coordinate system to which a given extent and/or position is referenced.

The ISO/TS 19139 XML encoding of ISO 19115 employs ISO 19136 (GML) as its basis for defining the resource bounding polygon.

ISO 19136 defines the XML attribute *srsName* as a URI that references a resource which specifies the spatial reference system applicable to the polygon. Figure 6 illustrates an example of its use.

Figure 6 – Example instance of gmd:EX_BoundingPolygon with srsName

```
<gmd:EX_BoundingPolygon>
  <gmd:polygon>
    <gml:Polygon gml:id="ResourceExtentPolygon"
                 srsName="http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_2D">
      <gml:exterior>
        <gml:LinearRing>
          <gml:pos>-74.92250 39.10333</gml:pos>
          <gml:pos>-74.92269 39.19386</gml:pos>
          <gml:pos>-74.66167 39.19414</gml:pos>
          <gml:pos>-74.66142 39.10306</gml:pos>
          <gml:pos>-74.92250 39.10333</gml:pos>
        </gml:LinearRing>
      </gml:exterior>
    </gml:Polygon>
  </gmd:polygon>
</gmd:EX_BoundingPolygon>
```

All CRS supported by the SMIS are registered in the GSIP Governance Namespace on the DoD Data Services Environment (DSE); see Annex B.2.4 for further information regarding these resources.

The SMIS currently supports seven types of coordinate reference systems, as specified in the following sections of this standard. Additional types of coordinate reference systems may be registered in the GSIP Governance Namespace In the DSE in the future.

6.2.2 Registered CRS Types

6.2.2.1 Geodetic 2D

The coordinate system is ellipsoidal and most commonly the datum will be World Geodetic System 1984 (WGS 84) however other geodetic datums of limited geographic extent may be employed for particular purposes. The following restrictions apply:

a. WGS84E_2D is the Recommended Best Practice. It shall be in accordance with World Geodetic System 1984 - Geographic 2D, as specified in NIMA TR8350.2 (3rd Edition, Amendment 1) and identified by the URI:

http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_2D

b. An alternative Geodetic 2D CRS for a limited-extent geographic region may be used only if that CRS has been first registered in the GSIP Governance Namespace in the DSE.

6.2.2.2 Geodetic 3D

The coordinate system is ellipsoidal and most commonly the datum will be WGS 84 however other geodetic datums of limited geographic extent may be employed for particular purposes. The third coordinate axis is perpendicular to the ellipsoid, positive upwards. The following restrictions apply:

a. 84E_3D is the Recommended Best Practice. It shall be in accordance with World Geodetic System 1984 - Geographic 3D, as specified in NIMA TR8350.2 (3rd Edition, Amendment 1) and identified by the URI:

http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_3D

b. An alternative Geodetic 3D CRS for a limited-extent geographic region may be used only if that CRS has been first registered in the GSIP Governance Namespace in the DSE.

6.2.2.3 Geocentric 3D

The coordinate system is Cartesian and the datum is always WGS 84 ; these establish a right-handed Earth-centric Earth-fixed (ECEF) reference frame. The following restrictions apply:

a. WGS84C_3D is the only supported Geocentric 3D CRS. It shall be in accordance with World Geodetic System 1984 - Earth Centered, Earth Fixed (ECEF), as specified in NIMA TR8350.2 (3rd Edition, Amendment 1) and identified by the URI:

http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84C_3D

6.2.2.4 Vertical

The coordinate system is linear, most commonly based on the geoid, and thus the third coordinate is an orthometric height ; less commonly the Vertical CRS will be based on a sounding datum, in which case the third coordinate is a depth. The following restrictions apply:

a. EGM96_H and EGM96_D are Recommended Best Practices. They shall be in accordance with the WGS 84 EGM96 Geoid as specified in NIMA TR8350.2 (3rd Edition, Amendment 1). This Vertical CRS is identified by one of two URIs depending on whether the coordinate is a height or depth value:

http://metadata.ces.mil/dse/ns/GSIP/crs/EGM96_H
http://metadata.ces.mil/dse/ns/GSIP/crs/EGM96_D

b. EGM08_H and EGM08_D are *emerging practices*. They shall be in accordance with the WGS 84 EGM08 Geoid. This Vertical CRS is identified by one of two URIs depending on whether the coordinate is a height or depth value:

http://metadata.ces.mil/dse/ns/GSIP/crs/EGM08_H
http://metadata.ces.mil/dse/ns/GSIP/crs/EGM08_D

c. MSL_H and MSL_D are deprecated practices. They shall be in accordance with the location- and epoch-free mean sea level (MSL). This Vertical CRS is identified by one of two URIs depending on whether the coordinate is a height or depth value:

http://metadata.ces.mil/dse/ns/GSIP/crs/MSL_H
http://metadata.ces.mil/dse/ns/GSIP/crs/MSL_D

d. An alternative Vertical CRS may be used only if that CRS has been first registered in the GSIP Governance Namespace in the DSE.

6.2.2.5 Projected 2D

The coordinate system is Cartesian, most commonly based on the Transverse Mercator or Polar Stereographic map projections.[19] Most commonly the datum will be WGS 84, however other geodetic datums of limited geographic extent may be employed for particular purposes. The following restrictions apply:

a. WGS84E_UTM* and WGS84E_UPS* are Recommended Best Practices. They shall be the universal grids as specified in DMA TM8358.2. UTM-based Projected 2D CRS are identified by one of 120 URIs of the following form, where each of the 60 UTM zones is split into separate Northern Hemisphere and Southern Hemisphere grid zones:

http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_UTM01N
http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_UTM01S
…
http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_UTM60N
http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_UTM60S

UPS-based Projected 2D CRS are identified by one of two URIs distinguished by the geographic pole at which the grid zone is specified:

http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_UPSN
http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_UPSS

b. An alternative Projected 2D CRS may be used only if that CRS has been first registered in the GSIP Governance Namespace in the DSE and it is either UTM- or UPS-based.

6.2.2.6 Compound = Geodetic 2D + Vertical

The coordinate system is ellipsoidal and most commonly the datum will be WGS 84 however other geodetic datums of limited geographic extent may be employed for particular purposes. Most commonly the Vertical CRS will be based on the geoid, thus the third coordinate is an orthometric height or altitude; less commonly the Vertical CRS will be based on a sounding datum, in which case the third coordinate is a depth. The following restrictions apply:

a. WGS84E_EGM96_H and WGS84E_EGM96_D are Recommended Best Practices. They shall be in accordance with World Geodetic System 1984 - Geographic, 2-Dimensional plus the Earth Gravity Model 1996 (EGM96), as specified in NIMA TR8350.2 (3rd Edition, Amendment 1). This compound CRS is identified by one of two URIs depending on whether the third coordinate is a height or depth value:

http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_EGM96_H
http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_EGM96_D

b. WGS84E_EGM08_H and WGS84E_EGM08_D are *emerging practices*. They shall be in accordance with World Geodetic System 1984 - Geographic, 2-Dimensional, as specified

[19] Note that these map projections are used as the basis for the Military Grid Reference System (MGRS).

in NIMA TR8350.2 (3rd Edition, Amendment 1) plus the Earth Gravity Model 2008 (EGM08). This compound CRS is identified by one of two URIs depending on whether the third coordinate is a height or depth value:

http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_EGM08_H
http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_EGM08_D

c. WGS84E_MSL_H and WGS84E_MSL_D are deprecated practices. They shall be in accordance with World Geodetic System 1984 - Geographic, 2-Dimensional, as specified in NIMA TR8350.2 (3rd Edition, Amendment 1) plus the location- and epoch-free mean sea level (MSL). This compound CRS is identified by one of two URIs depending on whether the third coordinate is a height or depth value:

http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_MSL_H
http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_MSL_D

d. An alternative Compound Geodetic 2D + Vertical CRS may be used only if that CRS has been first registered in the GSIP Governance Namespace in the DSE and it uses the MSL Vertical CRS.

Note that, as stated in Section 8.2, geographic extent as reported using *gmd:geographicElement* shall be the horizontal extent only, all coordinates reported shall be two-dimensional and vertical extent – if reported in the metadata – shall be reported using the *gmd:verticalElement*. Therefore it is invalid to specify a Geodetic 2D + Vertical Compound CRS when using *gmd:geographicElement*. However, this Compound CRS may be appropriate for use with other metadata elements in conforming SMIS instance documents.

6.2.2.7 Compound = Projected 2D + Vertical

Most commonly the Projected CRS (a Cartesian coordinate system) will be based on the Transverse Mercator or Polar Stereographic map projections and the Vertical CRS will be based on the geoid, thus the third coordinate is an orthometric height or altitude; less commonly the Vertical CRS will be based on a sounding datum, in which case the third coordinate is a depth. The following restrictions apply:

a. WGS84E_UTM*_EGM96_H, WGS84E_UTM*_EGM96_D, WGS84E_UPS*_EGM96_H and WGS84E_UPS*_EGM96_D are Recommended Best Practices. They shall be in accordance with either the UTM or UPS universal grids as specified in DMA TM8358.2, plus the Earth Gravity Model 1996 (EGM96), as specified in NIMA TR8350.2 (3rd Edition, Amendment 1).

UTM-based Projected 2D + Vertical CRS based on EGM96 are identified by one of 240 URIs of the following form, where each of the 60 UTM zones is split into separate Northern Hemisphere and Southern Hemisphere grid zones and each is further split according to whether the third coordinate is a height or depth value:

http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_UTM01N_EGM96_H
http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_UTM01N_EGM96_D
http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_UTM01S_EGM96_H
http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_UTM01S_EGM96_D
…
http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_UTM60N_EGM96_H
http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_UTM60N_EGM96_D
http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_UTM60S_EGM96_H
http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_UTM60S_EGM96_D

UPS-based Projected 2D + Vertical CRS based on EGM96 are identified by one of four URIs distinguished by the pole at which the grid zone is specified and whether the third coordinate is a height or depth value:

http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_UPSN_EGM96_H
http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_UPSN_EGM96_D
http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_UPSS_EGM96_H
http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_UPSS_EGM96_D

b. An alternative Compound Projected 2D + Vertical CRS may be used only if that CRS has first been registered in the GSIP Governance Namespace in the DSE and it is either UTM- or UPS-based.

Note that, as stated in Section 8.2, geographic extent as reported using *gmd:geographicElement* shall be the horizontal extent only, all coordinates reported shall be two-dimensional and vertical extent – if reported in the metadata – shall be reported using the *gmd:verticalElement*. Therefore it is invalid to specify a Geodetic 2D + Vertical Compound CRS when using *gmd:geographicElement*. However, this Compound CRS may be appropriate for use with other metadata elements in conforming SMIS instance documents.

6.3 *Character Encoding and Language Identification*

In order to support multi-lingual data and metadata it is necessary to specify the character encoding and language used in both the metadata instance and the resource data. This information is encoded in three parts and provides the basic content of the language tag specified in IETF RFC 4646 *Tags for Identifying Languages*:

- **language**: ISO 639-2 trigraph language code identifying the human language used.
- **languageCountry**: ISO 3166-1 trigraph code identifying the geographic region of the language.
- **characterSet**: MD_CharacterSetCode identifying the encoding used for the textual information.

IETF RFC 4646 is the Recommended Best Practice for identifying the language used in XML instance documents through the *xml:lang* attribute.[20] This supports transformation into other XML encodings that use the language attribute to portion-mark multi-lingual documents. Table 13 lists some example language code, language country code, and character set code triples for different regional languages.

Table 13 – Example Language, Country and Character Set Identification

Language	Language Code	Language Country	Character Set
English (American)	eng	USA	utf8
English (British)	eng	GBR	utf8
French (France)	fra	FRA	utf16
French (Canadian)	fra	CAN	utf16

ISO 19115, and thus ISO/TS 19139, represents this information-triple differently for the *gmd:MD_Metadata* and *gmd:MD_DataIdentification*.

[20] From the discussion in the W3C Recommendation "Extensible Markup Language (XML) 1.0 (Fourth Edition)": http://www.w3.org/TR/REC-xml/#sec-lang-tag.

Within a metadata instance the language identification of the metadata record itself uses XML attribute *locale* whose complex datatype *PT_Locale* consists of three fields. The XML encoding of *English (American)* is illustrated in Figure 7.

Figure 7 – Example Instance of gmd:PT_Locale illustrating Language Identification

```
<gmd:PT_Locale>
  <gmd:languageCode>
    <gmd:LanguageCode
      codeList="http://metadata.ces.mil/dse/ns/GPAS/codelist/iso639-2"
      codeListValue="eng"/>
  </gmd:languageCode>

  <gmd:country>
    <gmd:country
      codeList="http://metadata.ces.mil/dse/ns/DISDI/codelist/GENC-trigraph"
      codeListValue="USA"/>
  </gmd:country>

  <gmd:characterEncoding>
    <gmd:MD_CharacterSetCode
      codeList="http://metadata.ces.mil/dse/ns/DISDI/codelist/CharacterSetCode"
      codeListValue="utf8"/>
  </gmd:characterEncoding>
</gmd:PT_Locale>
```

6.4 *CharacterString Restriction*

6.4.1 Introduction

The ISO 19115 metadata standard contains several metadata elements typed as *CharacterString* and have been included as part of the SMIS. The use of the *CharacterString* type within ISO 19115 allows for free-text metadata content to be included in the metadata when a domain of values for a metadata element cannot be generally constrained.

The SMIS limits the value domain of several ISO 19115 metadata properties that use the *CharacterString* data type to either follow a restricted pattern or contain only a specific set of members.

6.4.2 Pattern Constraints

6.4.2.1 Telephone Number

The SDSFIE-M: Conceptual Schema specifies the consistent use of “internationalized” telephone numbers in accordance with ITU-T Recommendation E.123 Clause 2. That recommendation asserts the following constraints:

The *international prefix symbol* is a '+' (plus) and should precede the country code in the international number. It serves to remind the subscriber to dial the international prefix which differs from country to country and also serves to identify the number following as the international telephone number.

Spacing symbols are symbols that are used solely to separate parts of a telephone number from each other. They cannot be dial-able, procedural or information symbols. Grouping of digits in a telephone number should be accomplished **only** through the use of spaces in an international number. In the international number, spacing shall occur between the country code and the trunk code and between the trunk code and the subscriber number.

A slash (*/*) may **not** be used to indicate alternate numbers; instead separate element(s) shall be populated.

The SMIS captures this validation constraint through the use of an *xs:simpleType* that extends *xs:string* and asserts an appropriate *xs:pattern* facet, as specified in Figure 8.

Figure 8 – SMIS sdsfie:TelephoneNumber Specification

```
<xs:element name="TelephoneNumber" type="sdsfie:TelephoneNumberType"
             substitutionGroup="gco:CharacterString"/>

<xs:simpleType name="TelephoneNumberType">
  <xs:restriction base="xs:string">
    <xs:pattern value="\+[0-9]{0,5}[ ][\d]+[ ][\d][\d ]*"/>
  </xs:restriction>
</xs:simpleType>
```

A resulting specification of valid internationalized telephone numbers is illustrated in Figure 9.

Figure 9 – Example instance of gmd:CI_Telephone

```
<gmd:CI_Telephone>
  <gmd:voice>
    <sdsfie:TelephoneNumber>+1 703 555 1212</sdsfie:TelephoneNumber>
  </gmd:voice>

  <!-- An alternate telephone number. -->
  <gmd:voice>
    <sdsfie:TelephoneNumber>+1 703 555 4343</sdsfie:TelephoneNumber>
  </gmd:voice>

  <gmd:facsimile>
    <sdsfie:TelephoneNumber>+1 202 555 9999</sdsfie:TelephoneNumber>
  </gmd:facsimile>
</gmd:CI_Telephone>
```

6.4.2.2 Metadata Version Number

Section 5.3 specifies the SMIS schema XML attribute *version* shall always use the complete **Major.Minor.Corrigendum** number. The SMIS captures this validation constraint as applied also to the metadata instance content through the use of an *xs:simpleType* that extends *xs:string* and asserts an appropriate *xs:pattern* facet, as specified in Figure 10.

Figure 10 – SMIS sdsfie:MetadataStandardVersion Specification

```
<xs:element name="MetadataStandardVersion"
type="sdsfie:MetadataStandardVersionType"
              substitutionGroup="gco:CharacterString"/>

<xs:simpleType name="MetadataStandardVersionType">
  <xs:restriction base="xs:string">
    <xs:pattern value="[\d]+[.][\d]+[.][\d]+"/>
  </xs:restriction>
</xs:simpleType>
```

A resulting specification of a valid metadata standard version number is illustrated in Figure 11.

Figure 11 – Example instance of gmd:metadataStandardVersion

```
<gmd:metadataStandardVersion>
  <sdsfie:MetadataStandardVersion>2.1.0</sdsfie:MetadataStandardVersion>
</gmd:metadataStandardVersion>
```

6.4.2.3 Classification System

The SDSFIE-M: Conceptual Schema specifies the value of *gmd:classificationSystem* shall be "US CAPCO". The SMIS captures this validation constraint on the metadata instance content through the use of an *xs:simpleType* that extends *xs:string* and asserts an appropriate *xs:pattern* facet, as specified in Figure 12.

Figure 12 – SMIS sdsfie:ClassificationSystem Specification

```
<xs:element name="ClassificationSystem" type="sdsfie:ClassificationSystemType"
              substitutionGroup="gco:CharacterString"/>

<xs:simpleType name="ClassificationSystemType">
  <xs:restriction base="xs:string">
    <xs:pattern value="US CAPCO"/>
  </xs:restriction>
</xs:simpleType>
```

A resulting specification of a valid classification system is illustrated in Figure 13.

Figure 13 – Example instance of gmd:classificationSystem

```
<gmd:classificationSystem>
  <sdsfie:ClassificationSystem>US CAPCO</sdsfie:ClassificationSystem>
</gmd:classificationSystem>
```

6.4.3 Domain Constraints

In many cases, a profile of ISO 19115 (such as this one) includes the specification of a discrete value domain for one or more metadata elements. When a domain of values is identified, it may be specified in the profile as a *code list* (see B.2.2).

A *code list* allows for the encoding of a concept using the combination of a specific, defined value and an identification of the domain in which the value is defined. The advantage of the *code list* is the domain of values is defined externally to the XML schema and can be extended without changing the XML schema – the metadata instance simply references the *code list* and one of its members.

ISO/TS 19139 provides an encoding for the *code list* construct using the XML schema *xs:complexType*. In order to support use of *code lists* in place of free-text character strings in the XML encoding, ISO/TS 19139 defines the *gco:CodeListValue_Type* as an extension of *xs:string*. This allows for the definition of a *code list* within a profile that allows a code list value to be substituted in the XML instance for a character string value. The *gco:CodeListValue_Type* is as specified in Figure 14.

Figure 14 – ISO/TS 19139 gco:CodeListValue_Type Declaration

```
<xs:complexType name="CodeListValue_Type">
  <xs:simpleContent>
    <xs:extension base="xs: string">
      <xs:attribute name="codeList" type="xs:anyURI" use="required"/>
      <xs:attribute name="codeListValue" type="xs:anyURI" use="required"/>
      <xs:attribute name="codeSpace" type="xs:anyURI" use="optional"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<xs:element name="ScopeAmplificationCode" type="gco:CodeListValue_Type"
                          substitutionGroup="gco:CharacterString"/>
```

The *gco:CodeListValue_Type* type may be substituted for the type of any element that is a *CharacterString*. The XML attribute *codeList* is a URI identifying a (in the case of a URL) web-accessible resource containing the value domain used and the XML attribute *codeListValue* contains the value from the value domain being encoded in the metadata. The XML attribute *codeSpace* is not used in the SMIS.[21]

For example, the SMIS defines an element, *sdsfie:ScopeAmplificationCode*, used to provide additional information about the scope of a metadata instance. The declaration of the *sdsfie:ScopeAmplificationCode* is as specified in Figure 15. This element uses the

[21] The XML attribute *codeSpace* is an optional identifier (URI); when present it refers to the alternative expression of the *codeListValue* expressed as the value of the element. The *codeSpace* URI for the domain code (*e.g.,* an integer value used to denote the *codeListValue*) is "**domainCode**". For example, a full instance of CI_DateTypeCode expressed in the **domainCode** code space would appear as:

<CI_DateTypeCode codeList= "http://www.tc211.org/ISO19139/resources/codeList.xml#CI_DateTypeCode"
codeListValue="creation"
codeSpace="domainCode">0001</CI_DateTypeCode>

gco:CodeListValue_Type specified above and can be used in the metadata encoding schema in place of the character string value (*gco:CharacterString*).

Figure 15 – XSD nas:ScopeAmplificationCode Element

```
<xs:element name="ScopeAmplificationCode" type="gco:CodeListValue_Type"
                          substitutionGroup="gco:CharacterString"/>
```

The *sdsfie:ScopeAmplificationCode* element is used, *e.g.,* in the administrative metadata. Figure 16 is an extract of the definition of the *gmd:MD_Metadata* element and type illustrating how the scope and amplification elements appear in the ISO/TS 19139 XML encoding.

Figure 16 – ISO/TS 19139 gmd:MD_Metadata Element and Type Declaration Extract

```
<!-- From 'gmd' targetNamespace -->

<xs:element name="MD_Metadata" type="gmd:MD_Metadata_Type"/>

<xs:complexType name="MD_Metadata_Type">
  <xs:complexContent>
    <xs:extension base="gco:AbstractObject_Type">
      <xs:sequence>
        <! -- ... some elements omitted from this illustration -->

        <xs:element name="hierarchyLevel"
                          type="gmd:MD_ScopeCode_PropertyType"
                          minOccurs="0" maxOccurs="unbounded"/>

        <xs:element name="hierarchyLevelName"
                          type="gco:CharacterString_PropertyType"
                          minOccurs="0" maxOccurs="unbounded"/>

        <! -- ... some elements omitted from this illustration -->
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

The definition of the sub-element *hierarchyLevelName* allows a free-text string to be used to supply a value for this metadata element. By substituting for this the *sdsfie:ScopeAmplificationCode* type, the value encoded in the metadata may then be identified as being a specific value from a specified domain (which is used to interpret the meaning of the value).

An example instance of the *gmd:hierarchyLevel* and *gmd:hierarchyLevelName* sub-elements as used within a *gmd:MD_Metadata* instance document is illustrated in Figure 17.

Figure 17 – Example instance (partial) of the Profiled gmd:MD_Metadata

```
<gmd:MD_Metadata
    xmlns:sdsfie="http://metadata.ces.mil/dse/ns/DISDI/sdsfie"
    xmlns:gmd="http://www.isotc211.org/2005/gmd">
  <! -- ... some elements omitted from this illustration -->

  <gmd:hierarchyLevel>
    <gmd:MD_ScopeCode
      codeList="http://metadata.ces.mil/dse/ns/DISDI/codelist/ScopeCode"
      codeListValue="dataset"/>
  </gmd:hierarchyLevel>

  <gmd:hierarchyLevelName>
    <sdsfie:ScopeAmplificationCode

codeList="http://metadata.ces.mil/dse/ns/DISDI/codelist/ScopeAmplificationCode"
      codeListValue="collection"/>
  </gmd:hierarchyLevelName>

  <! -- ... some elements omitted from this illustration -->
</gmd:MD_Metadata>
```

6.5 *Conformance and Reuse*

This encoding schema is designed such that applications capable of processing ISO/TS 19139-conformant metadata instance documents will also be able to, without modification, process those portions of the SMIS that do not either extend ISO 19115 or revise (specialize) datatypes used in ISO 19115.

The XML schema developed for this profile reuses the XML schema elements of ISO/TS 19139. Extended metadata elements are defined in a separate XML schema definition file (*smis.xsd*) declaring the elements in the '**sdsfie**' namespace (see Section 5.2).

- Due to this separation, the profiled ISO/TS 19139 schema (*smisGmdProfile.xsd* and *smisGmiProfile.xsd*) may be used to validate metadata XML instances for conformance with this profile. In addition, the full set of ISO/TS 19139 XML schema definition files can be substituted for the profiled XSD files created for this profile and be similarly used to validate metadata XML instances conformant with this SMIS profile.
- Because the profiled ISO/TS 19139 schema has changed the obligation of some metadata elements (some optional elements in the ISO 19115 standard are mandatory in this profile), metadata XML instance documents that are valid against the full set of ISO/TS 19139 XSD files will not necessarily be conformant with this SMIS profile.

Reuse of the ISO/TS 19139 XML schema definitions permits existing ISO/TS 19139 software applications to be easily adapted for processing XML metadata instances conformant with the SMIS. With the exception of the *sdsfie:MD_Metadata* XML component, the majority of the content of a profile-conformant metadata XML instance uses elements declared in the *gmd*

namespace. The following assumptions have been made about software applications which are ISO/TS 19139-aware.

- In the case of class extension, such applications should be expected to ignore additional components until they have been enhanced to understand the additional content. This principally affects the use of *capcoMarkings* in *MD_SecurityConstraints*. It also affects the use of *sdsfie:BoundingPoint* as a means of specifying the (abstract) EX_GeographicExtent.
- In the case of datatype specialization, such applications will need to be enhanced, at least to the degree of handling a generic code list as a valid substitution for a *CharacterString*.[22]

In order to achieve the application-support objective for SMIS XML instance documents, the specified XML encoding schema is careful to first observe all requirements of ISO/TS 19139, and then extends that encoding schema in a maximally-consistent manner to address the unique additional requirements of SDSFIE-M.

7 Intelligence Community Metadata Schemas

7.1 *Abstract Data Definition*

The *Intelligence Community Abstract Data Definition*, Version 2 (IC.ADD.V2) defines a collection of abstract data elements, which constitute a top-down view of the types of data and metadata that are important to the Intelligence Community. IC.ADD.V2 Chapter 3, *Information Security Marking Data Elements*, describes abstract data elements for defining security information about documents and portions of documents such as classification, dissemination, handling, and declassification. These data elements support implementation of Executive Order 12958 – Classified National Security Information, as Amended (EO 12958; http://www.archives.gov/isoo/policy-documents/eo-12958-amendment.html), and Classified National Security Information – Final Rule (ISOO Directive 1; http://www.archives.gov/isoo/policy-documents/eo-12958-implementing-directive.pdf).

Executive Order (EO) 12958, as amended, “prescribes a uniform system for classifying, safeguarding, and declassifying national security information”, across national security disciplines, networks, services, and data.

The IC.ADD.V2 data elements serve as a critical bridge between the security marking requirements defined by the National Archives and Records Administration (NARA), Information Security Oversight Office (ISOO) and the IC security markings register maintained by the Office of the Director of National Intelligence (ODNI), Controlled Access Program Coordination Office (CAPCO), and information technology solutions that implement structured security marking metadata.

The IC.ADD.V2 data elements were developed to enable important advances designed to simultaneously improve and simplify the marking and handling of information at both the information product and portion-levels across the full range of security classifications. Upon this foundation:

- User interfaces for information security marking are intended to be developed.

[22] This substitution is an intended practice in accordance with ISO 19115. Implementations not prepared to handle such practices are deficient and need to be revised accordingly in order to come into compliance with ISO 19115. Such deficiencies are not the responsibility of this ISO 19115-conformant and ISO/TS 19139-conformant profile.

- Automated formatting of CAPCO-compliant portion marks, security banners, and classification/declassification blocks will be designed and built.
- Cross-domain security capabilities will be developed and deployed.

The Intelligence Community, in accordance with the IC.ADD.V2, has defined a set of XML Schema-specific Data Encoding Specifications (DES) including ones for Information Security Marking (ISM) and Need-To-Know (NTK) metadata.

The XML-based DES for ISM is described, and its use in the SMIS specified, in Section 7.2.

The XML-based DES for NTK is described, and its use in the SMIS specified, in Section 7.3.

7.2 *DES for Information Security Marking (ISM) Metadata*

7.2.1 Introduction

The *XML Data Encoding Specification for Information Security Marking Metadata* (DES.ISM.XML) specifies the technical implementation of an XML encoding for IC.ADD.V2, Chapter 3, *Information Security Marking Data Elements*.

The DES.ISM.XML includes:

- **Encoding Schemas** –
  - XML Schema (XSD) files.
  - Extensible Markup Language (XML) Controlled Vocabulary Enumeration (CVE) files (value enumerations from the CAPCO Register and other authoritative sources of values used by the DES).
  - Extensible Stylesheet Language Transformation (XSLT) files for rendering security marks.
- **Constraint Rules** –
  - Data validation constraints beyond those specified by the structure of the XML Schema; these ensure that the content of instance documents complies with the constraints as specified in applicable IC policy guidance. These rules are written in plain English phrases; however, knowledge of the DES.ISM.XML schema is required in order to understand the rules.
- **Development Guidance** –
  - Mappings of the XML element and attributes defined by the DES to appropriate IC.ADD.V2 data elements.
  - Descriptions of how particular encoding situations should be handled using the features provided by the DES.

This SMIS employs DES.ISM.XML Version 9 (17 July 2012), which incorporates Schematron-based constraint rules (see Annex B.4) and therefore significantly enhances the ability of applications conforming to the DES.ISM.XML to automatically validate XML instance documents.

Future versions of the SMIS will potentially adopt updated versions of DES.ISM.XML when they are released.

The DES.ISM.XML.V9 schema consists of *ism/9.0.0/IC-ISM.xsd*, *ism/9.0.0/CVEGeneratedTypes.xsd* and the contents of the folder *ism/CVEGenerated*.

The applicable schema files are packaged with the XML schemas of the SMIS for convenience.

> **Note**: The supplied files are those which are publicly released by the IC CIO. Full compliance to the DES.ISM.XML.V9 may be achieved by replacing the schema files packaged with the XML encoding of the SMIS with those distributed by the IC CIO on Intelink at:
>
> ► https://www.intelink.gov/sites/odni/cio/ea/library/data%20specifications/ism/

7.2.2 ism:DESVersion

The DES.ISM.XML schema does not specify version information using the XML Namespace. It instead defines the *ism:DESVersion* XML attribute that must be specified on the root node of any conforming XML instance document. This is accomplished through the use of the XML attribute group *ism:ISMRootNodeAttributeGroup*; it is defined as "An attribute group to be used on the root node of a schema implementing ISM."

The XML attribute group *ism:ISMRootNodeAttributeGroup* for DES.ISM.XML.V9 is as specified in Figure 18.

Figure 18 – DES.ISM.XML.V9 Root Node Attribute Group

```
<xsd:attributeGroup name="ISMRootNodeAttributeGroup">
  <xsd:attribute name="DESVersion" type="xsd:int"
                         use="required" fixed="9" form="qualified"/>
</xsd:attributeGroup>
```

The *sdsfie:SMISRootNodeAttributeGroup* XML attribute group (*icDESInclude.xsd*), which includes the *ism:ISMRootNodeAttributeGroup*, is used to encode the required version information as specified in Figure 19.

Figure 19 – sdsfie:SMISRootNodeAttributeGroup

```
<xs:import namespace="urn:us:gov:ic:ism"
                         schemaLocation="./ic/ism/9.0.0/IC-ISM.xsd"/>
<xs:import namespace="urn:us:gov:ic:ntk"
                         schemaLocation="./ic/ntk/7.0.0/IC-NTK.xsd"/>

<xs:attributeGroup name="SMISRootNodeAttributeGroup">
  <xs:attributeGroup ref="ism:ISMRootNodeAttributeGroup"/>
  <xs:attributeGroup ref="ism:ResourceNodeAttributeGroup"/>
  <xs:attributeGroup ref="ntk:NTKRootNodeAttributeGroup"/>
</xs:attributeGroup>
```

In SDSFIE-M, the ISO 19115 *MD_Metadata* UML class was extended to include an attribute using a datatype class representing the SMIS root node attribute group .

In the XML schema for the SMIS extensions (*smis.xsd*) the *sdsfie:MD_Metadata* element is defined to be substitutable for the *gmd:MD_Metadata* element. The *sdsfie:MD_Metadata* uses the *sdsfie:SMISRootNodeAttributeGroup* to encode the required ISM version information. The *sdsfie:MD_Metadata* element and its type definition are as specified in Figure 20.

Figure 20 – ISO/TS 19139 gmd:MD_Metadata Extension for ISM Version and Resource Specification

```
<xs:element name="MD_Metadata" type="sdsfie:MD_Metadata_Type"
                          substitutionGroup="gmd:MD_Metadata"/>

<xs:complexType name="MD_Metadata_Type">
  <xs:complexContent>
    <xs:extension base="gmd:MD_Metadata_Type">
      <xs:attributeGroup ref="sdsfie:SMISRootNodeAttributeGroup"/>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

The *sdsfie:MD_Metadata* element uses the *ism:DESVersion* attribute, as illustrated in the example instance in Figure 21, to identify the version of DES.ISM.XML being employed.

Figure 21 – Example instance of nas:MD_Metadata with Version Information

```
<sdsfie:MD_Metadata xmlns:sdsfie="http://metadata.ces.mil/dse/ns/DISDI/sdsfie"
  xmlns:gmd="http://www.isotc211.org/2005/gmd"
  xmlns:gco="http://www.isotc211.org/2005/gco"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://metadata.ces.mil/dse/ns/ DISDI/sdsfie ./smis.xsd"
  xmlns:ism="urn:us:gov:ic:ism"
  xmlns:ntk="urn:us:gov:ic:ntk"
  ism:DESVersion="9"
  ntk:DESVersion="7"
  ism:resourceElement="true" ism:createDate="2014-06-21"
  ism:classification="U" ism:ownerProducer="USA">

  <! -- ... some elements omitted from this illustration -->
</sdsfie:MD_Metadata>
```

7.2.3 ism:SecurityAttributesGroup

In SDSFIE-M the ISO 19115 *MD_SecurityConstraints* UML class was extended to include a conditional attribute using a datatype class representing the DES.ISM.XML security attributes group. Since *MD_SecurityConstraints* is used to indicate the security classifications of both the metadata and the resource, extending this class allows for the inclusion of CAPCO security markings for both as well.

The DES.ISM.XML security markings are implemented in *IC-ISM.xsd* as an XML attribute group, with each XML attribute member corresponding to one of the CAPCO security marking

elements. The XML attribute group *ism:SecurityAttributesGroup* for ISM V7[23] is as specified in Figure 22.

Figure 22 – DES.ISM.XML.V9 Security Attributes Group

```
<xsd:attributeGroup name="SecurityAttributesGroup">
  <xsd:attribute ref="classification" use="required"/>
  <xsd:attribute ref="ownerProducer" use="required"/>
  <xsd:attribute ref="SCIcontrols" use="optional"/>
  <xsd:attribute ref="SARIdentifier" use="optional"/>
  <xsd:attribute ref="disseminationControls" use="optional"/>
  <xsd:attribute ref="displayOnlyTo" use="optional"/>
  <xsd:attribute ref="FGIsourceOpen" use="optional"/>
  <xsd:attribute ref="FGIsourceProtected" use="optional"/>
  <xsd:attribute ref="releasableTo" use="optional"/>
  <xsd:attribute ref="nonICmarkings" use="optional"/>
  <xsd:attribute ref="classifiedBy" use="optional"/>
  <xsd:attribute ref="compilationReason" use="optional"/>
  <xsd:attribute ref="derivativelyClassifiedBy" use="optional"/>
  <xsd:attribute ref="classificationReason" use="optional"/>
  <xsd:attribute ref="nonUSControls" use="optional"/>
  <xsd:attribute ref="derivedFrom" use="optional"/>
  <xsd:attribute ref="declassDate" use="optional"/>
  <xsd:attribute ref="declassEvent" use="optional"/>
  <xsd:attribute ref="declassException" use="optional"/>
</xsd:attributeGroup>
```

In the XML schema for the SMIS extensions (*smis.xsd*) the *sdsfie:MD_SecurityConstraints* element is defined to be substitutable for the *gmd:MD_SecurityConstraints* element. The *sdsfie:MD_SecurityConstraints* element contains an additional sub-element named *sdsfie:capcoMarking* that has no direct content, but uses the *sdsfie:SecurityAttributesGroup* (which in *icDESInclude.xsd* is substituted for the *ism:SecurityAttributesGroup*) to encode the security markings and restrictions.

The *sdsfie:MD_SecurityConstraints* element and its type definition are as specified in Figure 23.

Figure 23 – ISO/TS 19139 gmd:MD_SecurityConstraints Extension for CAPCO Markings

```
<xs:element name="MD_SecurityConstraints" type="sdsfie:MD_SecurityConstraints_Type"
                          substitutionGroup="gmd:MD_SecurityConstraints"/>

<xs:complexType name="MD_SecurityConstraints_Type">
  <xs:complexContent>
    <xs:extension base="gmd:MD_SecurityConstraints_Type">
```

[23] Note that the exact set of XML attributes included in this attribute group varies with each version of DES.ISM.XML.

```
      <xs:sequence>
        <xs:element name="capcoMarking">
          <xs:complexType>
            <xs:attributeGroup ref="sdsfie:SecurityAttributesGroup"/>
          </xs:complexType>
        </xs:element>

        <! -- ... some elements omitted from this illustration -->

      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

The *sdsfie:MD_SecurityConstraints* element inherits the mandatory *gmd:classification* and mandatory[24] *gmd:classificationSystem* elements from *gmd:MD_SecurityConstraints* and extends the ISO/TS 19139 element with the addition of the mandatory *sdsfie:capcoMarking* XML element.

SDSFIE-M specifies the value of *gmd:classificationSystem* shall be "US CAPCO". As identified in Section 5.8.3 this is accomplished through the use of the *sdsfie:ClassificationSystem* type whose domain is a constrained string value (see Section 6.4.2.3). The *sdsfie:MD_SecurityConstraints* element uses the *ism:SecurityAttributesGroup* to properly mark the security restrictions applicable to the resource. These uses are illustrated in the example instance in Figure 24.

[24] The XML element was optional in ISO 19115 but was revised to mandatory in the SMIS-specified ISO/TS 19139 Restriction Profile; see Section 5.7.15.7.

Figure 24 – Example instance of nas:MD_SecurityConstraints

```
<sdsfie:MD_SecurityConstraints
      xmlns:sdsfie="http://metadata.ces.mil/dse/ns/DISDI/sdsfie"
      xmlns:gmd="http://www.isotc211.org/2005/gmd"
      xmlns:ism="urn:us:gov:ic:ism" ism:DESVersion="9"
      xmlns:ntk="urn:us:gov:ic:ntk" ntk:DESVersion="7">

    <gmd:classification>
      <gmd:MD_ClassificationCode

  codeList="http://metadata.ces.mil/dse/ns/DISDI/codelist/ClassificationCode"
        codeListValue="unclassified"/>
    </gmd:classification>

    <gmd:classificationSystem>
      <sdsfie:ClassificationSystem>US CAPCO</sdsfie:ClassificationSystem>
    </gmd:classificationSystem>

    <sdsfie:capcoMarking ism:classification="U" ism:ownerProducer="USA"/>

</sdsfie:MD_SecurityConstraints>
```

See the *XML Data Encoding Specification for Information Security Marking Metadata*, Version 9, 17 July 2012, for additional information regarding correctly populating the values of the *ism:SecurityAttributesGroup* XML attributes.

See SDSFIE-M: Conceptual Model for additional information regarding consistently populating the values of the *gmd:classification*, *gmd:classificationSystem* and *sdsfie:capcoMarking* XML elements.

7.2.4 ISM Resource Security Mark

The IC.ADD.V2, Chapter 2 – *Information Resource Description Data Elements* specifies the Resource Security Mark data element, defined as:

> "The overall security classification and security handling instructions carried by the resource. Resource Security Mark applies to the resource-level classification, SCI controls, dissemination controls, non-IC markings, and other security provisions prescribed by Executive Order 12958, as amended, the Information Security Oversight Office (ISOO) Directive 1 of the National Archives and Records Administration, and the Intelligence Community marking registry maintained by the Controlled Access Program Coordination Office (CAPCO). These values are prominently presented, in the case of intelligence publications, at the top and bottom of every page and in other specified locations. See Chapter 3 – Information Security Marking Information Security Marking Data Elements for refinements of this data element."

The DES.ISM.XML schema defines the XML attribute group *ism:ResourceNodeAttributeGroup* that must be specified on the resource node of any conforming XML instance document. It is defined as: "An attribute group to be used on the element that represents the resource node of an instance document. This node's ISM attributes would be used to generate banner marks and

the E.O. 12958 classification authority block. Implementing Schemas might use this on the Root node or any other node."

The XML attribute group *ism:ResourceNodeAttributeGroup* for DES.ISM.XML.V9 is as specified in Figure 25.

Figure 25 – DES.ISM.XML.V9 Resource Node Attribute Group

```
<xsd:attributeGroup name="ResourceNodeAttributeGroup">
  <xsd:attribute ref="resourceElement" use="required" fixed="true"/>
  <xsd:attribute ref="createDate" use="required"/>
  <xsd:attribute ref="compliesWith" use="optional"/>
  <xsd:attributeGroup ref="SecurityAttributesGroup"/>
</xsd:attributeGroup>
```

The *sdsife:SMISRootNodeAttributeGroup* attribute group (*icDESInclude.xsd*), which includes the *ism:ResourceNodeAttributeGroup*, is used to encode the required resource security mark information as specified in Figure 19.

In the XML schema for the SMIS extensions (*smis.xsd*) the *sdsfie:MD_Metadata* element is defined to be substitutable for the *gmd:MD_Metadata* element. The *sdsfie:MD_Metadata* uses the *sdsfie:SMISRootNodeAttributeGroup* to encode the required resource security mark information. The *sdsfie:MD_Metadata* element and its type definition are as specified in Figure 20.

The *sdsfie:MD_Metadata* element uses the four XML attributes specified by the *ism:ResourceNodeAttributeGroup* (see Figure 25), as to identify the element that represents the resource node of an instance document. An example of its use is illustrated in Figure 26.

Figure 26 – Example instance of sdsfie:MD_Metadata with Resource Information

```
<sdsfie:MD_Metadata xmlns:sdsfie="http://metadata.ces.mil/dse/ns/DISDI/sdsfie"
  xmlns:gmd="http://www.isotc211.org/2005/gmd"
  xmlns:gco="http://www.isotc211.org/2005/gco"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://metadata.ces.mil/dse/ns/DISDI/sdsfie ./smis.xsd"
  xmlns:ism="urn:us:gov:ic:ism"
  xmlns:ntk="urn:us:gov:ic:ntk"
  ism:DESVersion="9"
  ntk:DESVersion="7"
  ism:resourceElement="true" ism:createDate="2014-05-16"
  ism:classification="U" ism:ownerProducer="USA">

  <! -- ... some elements omitted from this illustration -->
</sdsfie:MD_Metadata>
```

Values for the minimum set of XML attributes *createDate*, *classification* and *ownerProducer* on the resource node of an instance document are determined as follows:

- The value of *createDate* shall be the same as the `gmd:dateStamp/gco:Date` XML element.
- The values of *classification*, *ownerProducer* and any additional ISM.XML attributes from the *ism:SecurityAttributesGroup* shall be based on those assigned for the corresponding XML attributes of `sdsfie:MD_SecurityConstraints/sdsfie:capcoMarking` as used by the:
    - `gmd:metadataConstraints`, and
    - `gmd:identificationInfo/sdsfie:MD_DataIdentification/gmd:resourceConstraints`

    as determined by applicable banner and E.O. 12958 classification authority block marking requirements.

The value of the (conditional) *compliesWith* XML attribute shall specify any additional constraint ruleset (*e.g.*, DoD5230.24) to which the XML instance document conforms.

7.2.5 ism:Notice

In the DES.ISM.XML the *ism:Notice* XML element may be used to represent information concerning a "well-defined" security notice; *e.g.*, a DoD Distribution statement D from DoD Directive 5230.24.

The XML element *ism:Notice* and its associated XML attribute groups are as specified in Figure 27

Figure 27 – DES.ISM.XML.V9 Notice and ISMNoticeAttributeGroup

```
<xsd:element name="Notice">
  <xsd:complexType>
    <xsd:sequence minOccurs="1" maxOccurs="1">
      <xsd:element ref="NoticeText" minOccurs="1" maxOccurs="unbounded"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="NoticeAttributesOptionGroup"/>
  </xsd:complexType>
</xsd:element>

<xsd:attributeGroup name="NoticeAttributesOptionGroup">
  <xsd:attributeGroup ref="ISMNoticeAttributeGroup"/>
  <xsd:attributeGroup ref="SecurityAttributesOptionGroup"/>
</xsd:attributeGroup>

<xsd:attributeGroup name="ISMNoticeAttributeGroup">
  <xsd:attribute ref="noticeType" use="optional"/>
  <xsd:attribute ref="noticeReason" use="optional"/>
  <xsd:attribute ref="noticeDate" use="optional"/>
  <xsd:attribute ref="unregisteredNoticeType" use="optional"/>
```

```
</xsd:attributeGroup>
```

To include security markings on these notices, the i*sm:NoticeAttributeGroup* contains all of the attributes in the *ism:ISMNoticeAttributeGroup* as well as the security marking attributes defined in the *ism:SecurityAttributesOptionGroup*.

The XML attributes comprising the *ism:ISMNoticeAttributeGroup* are employed as follows:

- The XML attribute *noticeType* is an indicator the XML element contains a security-related notice and is used to categorize which of the required notices is specified in the XML element. These categories include those described in the CAPCO Register and Manual[25], as well as additional well-defined and formally recognized security notice types described in other directives. The permissible values for this attribute are defined in the Controlled Value Enumeration (CVE) CVEnumISMNotice.xml.
- The XML attribute *noticeDate* specifies the date associated with the notice, such as the date it was issued.
- The XML attribute *noticeReason* specifies the reason a notice was issued.
- The XML attribute *unregisteredNoticeType* is used to represent notices not categorized according to the CAPCO Register and Manual and/or whose values do not appear in CVEnumISMNotice.xml. This attribute can be used to designate specification-specific security notices that may not be sufficiently defined to be recognized by CAPCO.

The *sdsfie:notices* element (from *icDESInclude.xsd*) allows for multiple occurances of *ism:Notice*; it is as specified in Figure 28.

Figure 28 – sdsfie:notices Element

```
<xs:element name="notices">
  <xs:complexType>
    <xs:sequence>
      <xs:element ref="ism:Notice" maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:complexType>
</xs:element>
```

Figure 29 illustrates an example instance of the use of notice information with *sdsfie:MD_SecurityConstraints*.

[25] Director of National Intelligence (DNI), Special Security Directorate (SSD), Controlled Access Program Coordination Office (CAPCO). Intelligence Community Authorized Classification and Control Markings Register and Manual. Unclassified FOUO version. Volume 5. Edition 1 (Version 5.1). Effective: 30 December 2011. Available online at: https://www.intelink.gov/sites/ssc/divisions/capco/CAPCO Resources/CAPCO_Register and Manual v5.1_04Jan11_FOUO.pdf

Figure 29 – Example instance of sdsfie:MD_SecurityConstraints with Notice Information

```
<sdsfie:MD_SecurityConstraints
      xmlns:sdsfie="http://metadata.ces.mil/dse/ns/DISDI/sdsfie"
      xmlns:gmd="http://www.isotc211.org/2005/gmd"
      xmlns:ism="urn:us:gov:ic:ism" ism:DESVersion="9">
      xmlns:ntk="urn:us:gov:ic:ntk" ntk:DESVersion="7">

    <gmd:classification>
      <gmd:MD_ClassificationCode

  codeList="http://metadata.ces.mil/dse/ns/DISDI/codelist/ClassificationCode"
        codeListValue="unclassified"/>
    </gmd:classification>

    <! -- ... some elements omitted from this illustration -->

    <sdsfie:notices>
      <ism:Notice ism:noticeDate="2014-05-16"
                  ism:noticeType="DS">
        <ism:NoticeText ism:classification="U" ism:ownerProducer="USA">
              Contact the data distributor for specific details.</ism:NoticeText>
      </ism:Notice>

      <ism:Notice ism:noticeDate="2014-05-16"
                  ism:unregisteredNoticeType="General Warning">
        <ism:NoticeText ism:classification="U" ism:ownerProducer="USA">
              Data release may be restricted.</ism:NoticeText>
      </ism:Notice>
    </sdsfie:notices>

    <! -- ... some elements omitted from this illustration -->

</sdsfie:MD_SecurityConstraints>
```

See the *XML Data Encoding Specification for Information Security Marking Metadata*, Version 9, 17 July 2012, for additional information regarding correctly populating the values of the Notice XML elements.

7.3 *DES for Need-To-Know (NTK) Metadata*

7.3.1 Introduction

The *XML Data Encoding Specification for Need-To-Know Metadata* (DES.NTK.XML) specifies the technical implementation of an XML encoding for need-to-know metadata.[26] These

[26] Need-to-know metadata is not specified in IC.ADD.V2 but presumably will be so in a future version.

metadata are used to represent the system-specific properties assigned to an information resource that will be used, in conjunction with information about the user, and possibly other information, to determine the user's access to the data. A single information resource may include multiple occurrences of NTK metadata in order to specify NTK information according to multiple, different access systems.

The DES.NTK.XML includes:

- **Encoding Schema** –
  - XML Schema (XSD) file.
- **Constraint Rules** –
  - Data validation constraints beyond those specified by the structure of the XML Schema; these ensure the content of instance documents complies with the constraints as specified in applicable IC policy guidance. These rules are written in plain English phrases; however, knowledge of the DES.NTK.XML schema is required in order to understand the rules.

This SMIS employs DES.NTK.XML Version 7 (17 July 2012), which incorporates Schematron-based constraint rules (see Annex B.4) and therefore significantly enhances the ability of applications conforming to the DES.NTK.XML to automatically validate XML instance documents.

Future versions of the SMIS will adopt updated versions of DES.NTK.XML when they are released.

The DES.NTK.XML.V7 schema consists of *ntk/7.0.0/IC-NTK.xsd* and is dependent on the DES.ISM.XML.V9 schema (*ism/9.0.0/IC-ISM.xsd*).

The applicable schema file is packaged with the XML schemas of the SMIS for convenience.

> **Note**: The supplied file is publicly released by the IC CIO. Full compliance to the DES.NTK.XML.V7 may be achieved by replacing the schema file packaged with the XML encoding of the SMIS with that distributed by the IC CIO on Intelink at:
>
> ► https://www.intelink.gov/sites/odni/cio/ea/library/data%20specifications/ntk/

7.3.2 ntk:DESVersion

The DES.NTK.XML schema does not specify version information using the XML Namespace. It instead defines the *ntk:DESVersion* XML attribute that must be specified on the root node of any conforming XML instance document. This is accomplished through the use of the XML attribute group *ntk:NTKRootNodeAttributeGroup*; it is defined as "An attribute group to be used on the root node of a schema implementing NTK."

The XML attribute group *ntk:NTKRootNodeAttributeGroup* for DES.NTK.XML.V7 is as specified in Figure 30.

Figure 30 – DES.NTK.XML.V7 Root Node Attribute Group

```
<xsd:attributeGroup name="NTKRootNodeAttributeGroup">
  <xsd:attribute name="DESVersion" type="xsd:int"
                         use="required" fixed="5" form="qualified"/>
</xsd:attributeGroup>
```

The *sdsfie:SMISRootNodeAttributeGroup* XML attribute group (*icDESInclude.xsd*), which includes the *ntk:NTKRootNodeAttributeGroup*, is used to encode the required version information as specified in Figure 19.

In the XML schema for the SMIS extensions (*smis.xsd*) the *sdsfie:MD_Metadata* element is defined to be substitutable for the *gmd:MD_Metadata* element. The *sdsfie:MD_Metadata* uses the *sdsfie:SMISRootNodeAttributeGroup* to encode the required NTK version information. The *sdsfie:MD_Metadata* element and its type definition are as specified in Figure 20.

The *sdsfie:MD_Metadata* element uses the *ntk:DESVersion* attribute, as illustrated in the example instance in Figure 21, to identify the version of DES.NTK.XML being employed.

Note that NTK metadata is dependent on ISM metadata (*e.g.,* see the use of the *ism:SecurityAttributesGroup* in Figure 31); the proper use of *sdsfie:MD_Metadata* (and thus *sdsfie:SMISRootNodeAttributeGroup*) ensures that this dependency is correctly managed.

7.3.3 ntk:Access

In SDSFIE-M the ISO 19115 *MD_SecurityConstraints* UML class was extended to include an optional attribute using a datatype class representing the DES.NTK.XML (need-to-know) access element. Since *MD_SecurityConstraints* is used to indicate the security classifications of both the metadata and the resource, extending this class allows for the inclusion of need-to-know markings for both as well.

The DES.NTK.XML need-to-know markings are implemented in *IC-NTK.xsd* as an XML element, with each subordinate XML element corresponding to one of the alternative group-specification mechanisms. The XML element *ism:Access* is as specified in Figure 31.

Figure 31 – DES.NTK.XML.V7 Access Element

```
<xsd:element name="Access">
  <xsd:complexType>
    <xsd:all minOccurs="1" maxOccurs="1">
      <xsd:element ref="ntk:AccessIndividualList" minOccurs="0" maxOccurs="1"/>
      <xsd:element ref="ntk:AccessGroupList" minOccurs="0" maxOccurs="1"/>
      <xsd:element ref="ntk:AccessProfileList" minOccurs="0" maxOccurs="1"/>
    </xsd:all>
    <xsd:attributeGroup ref="ism:SecurityAttributesGroup"/>
  </xsd:complexType>
</xsd:element>
```

In the XML schema for the SMIS extensions (*smis.xsd*) the *sdsfie:MD_SecurityConstraints* element is defined to be substitutable for the *gmd:MD_SecurityConstraints* element. The *sdsfie:MD_SecurityConstraints* element contains an additional sub-element named *sdsfie:needToKnow* that uses the XML element *ntk:Access* to encode the access constraints. The *sdsfie:needToKnow* element (from *icDESInclude.xsd*) is as specified in Figure 32.

Figure 32 – nas:needToKnow Element

```
<xs:element name="needToKnow">
  <xs:complexType>
    <xs:sequence>
      <xs:element ref="ntk:Access"/>
```

```
    </xs:sequence>
  </xs:complexType>
</xs:element>
```

Figure 24 illustrates an example instance of the use of need-to-know information with *sdsfie:MD_SecurityConstraints*.

Figure 33 – Example instance of sdsfie:MD_SecurityConstraints with NTK Information

```
<sdsfie:MD_SecurityConstraints
      xmlns:sdsfie="http://metadata.ces.mil/dse/ns/DISDI/sdsfie"
      xmlns:gmd="http://www.isotc211.org/2005/gmd"
      xmlns:ism="urn:us:gov:ic:ism" ism:DESVersion="9">
      xmlns:ntk="urn:us:gov:ic:ntk" ntk:DESVersion="7">

    <gmd:classification>
      <gmd:MD_ClassificationCode

  codeList="http://metadata.ces.mil/dse/ns/DISDI/codelist/ClassificationCode"
        codeListValue="unclassified"/>
    </gmd:classification>

    <! -- ... some elements omitted from this illustration -->

    <sdsfie:needToKnow>
      <ntk:Access ism:classification="U" ism:ownerProducer="USA">
        <ntk:AccessGroupList>
          <ntk:AccessGroup ism:classification="U" ism:ownerProducer="USA">
            <ntk:AccessSystemName
                  ism:classification="U"
                  ism:ownerProducer="USA">IandESystem</ntk:AccessSystemName>
            <ntk:AccessGroupValue
                  ism:classification="U"
                  ism:ownerProducer="USA">User</ntk:AccessGroupValue>
          </ntk:AccessGroup>
        </ntk:AccessGroupList>
      </ntk:Access>
    </sdsfie:needToKnow>

    <! -- ... some elements omitted from this illustration -->

</sdsfie:MD_SecurityConstraints>
```

See the *XML Data Encoding Specification for Need-To-Know Metadata*, Version 7, 17 July 2012, for additional information regarding correctly populating the values of the NTK XML elements.

8 Content-specific Encoding Notes

8.1 *Distance and other Measures*

ISO 19115 specifies numerous metadata concepts that are measures. The SDSFIE-M Conceptual Schema includes the ability to specify a ground distance measure as an alternative means to describe the resolution of a dataset (the other option being to specify a map scale factor).

The ISO/TS 19139 content model for *gmd:MD_Resolution* specified in Figure 34.

Figure 34 – ISO/TS 19139 gmd:MD_Resolution Content Model

```
<xs:complexType name="MD_Resolution_Type">
  <xs:choice>
    <xs:element name="equivalentScale"
                type="gmd:MD_RepresentativeFraction_PropertyType"/>
    <xs:element name="distance"
                type="gco:Distance_PropertyType"/>
  </xs:choice>
</xs:complexType>
<xs:element name="MD_Resolution" type="gmd:MD_Resolution_Type"/>

 <!—from the GCO namespace -->
<xs:complexType name="Distance_PropertyType">
  <xs:sequence minOccurs="0">
    <xs:element ref="gco:Distance"/>
  </xs:sequence>
  <xs:attribute ref="gco:nilReason"/>
</xs:complexType>
<xs:element name="Distance" type="gml:LengthType" substitutionGroup="gco:Length"/>

 <!—from the GML namespace -->
<xs:complexType name="LengthType">
  <xs:simpleContent>
    <xs:extension base="gml:MeasureType"/>
  <xs:/simpleContent>
<xs:/complexType>

<xs:complexType name="MeasureType">
  <xs:simpleContent>
    <xs:extension base="double">
      <xs:attribute name="uom" type="gml:UomIdentifier" use="required"/>
   <xs:/extension>
  <xs:/simpleContent>
```

```
<xs:/complexType>

<xs:simpleType name="UomIdentifier">
  <xs:union memberTypes="gml:UomSymbol gml:UomURI"/>
<xs:/simpleType>
```

The XML attribute *uom* is used to identify the unit of measure for *gco:Distance*. An example instantiation of *gmd:MD_Resolution* is illustrated in Figure 35.

Figure 35 – Example gmd:MD_Resolution

```
<gmd:MD_Resolution>
  <gmd:Distance>
    <gco:Distance
      uom="http://metadata.ces.mil/dse/ns/GSIP/uom/length/metre">30</gco:Distance>
  </gmd:Distance>
</gmd:MD_Resolution>
```

The unit of measure is *metre*[27] as specified in the units of measure code list registered in the DSE. The value is reported as a real value (based on the *xs:double*). Thus, in this example the reported value is 30.0 meters.

Instance documents conformant to the SMIS that use *gco:Distance* shall only use units of measure registered in the 'uom/length' component of the GSIP Governance Namespace in the DSE:

http://metadata.ces.mil/dse/ns/GSIP/uom/length

The members of this code list specify length quantities, where length is the quantity of a linear extent; *e.g.*, "metre", "foot", "fathom", "nauticalMile".

Instance documents conformant to the SMIS that specify measures shall only use units of measure registered in the 'uom' component of the GSIP Governance Namespace in the DSE:

http://metadata.ces.mil/dse/ns/GSIP/uom

For additional information regarding the proper specification and use of units of measure see Section 6.1.4 and Annex B.2.3.

8.2 *Geographic Extent*

The geographic extent reported in the metadata for a resource may be specified either as a description, a bounding box (an approximate eastern- and western-most longitude and northern- and southern-most latitude), a bounding polygon, or as a point. The extent may be reported using multiple representations, simultaneously. It may be desirable to both identify the spatial extent using a coarse representation such as a point or a bounding box and to specify a more detailed extent using a polygon.

[27] Note that the referenced code list follows ISO 80000-3 *Quantities and units – Part 3: Space and time*, hence "metre" instead of the US-specific term "meter".

The extent reported using *gmd:geographicElement* shall be the horizontal extent only. All coordinates reported shall be two-dimensional. If vertical extent is to be reported in the metadata, it shall be reported only using the *gmd:verticalElement*.

The coordinate reference system for the positions of the horizontal extent is specified using the XML attribute *srsName*. The coordinate reference system for the vertical extent is specified using the XML attribute *xlink:href*. Mechanisms for identifying specific coordinate reference systems are specified in Section 6.1.4 and Annex B.2.4.

Two spatial extent representations directly use ISO 19136: the bounding polygon and the bounding point.

For the bounding polygon, the object *gml:Polygon* is used to contain the positions making up the exterior ring of the polygon and the interior rings (if any). Interior rings are used to indicate "holes" in the area bounded by the exterior ring that are to be specifically excluded from search and discovery for the resource content. This may not be conceptually the same as the "void areas" of the resource[28] and metadata authors are advised to consult the content preparation specification for their resource content in order to determine if interior rings (holes) should be specified in the geographic extent of their metadata.

The example in Figure 36 illustrates a bounding polygon instance with has no interior rings.

Figure 36 – Example instance of gmd:EX_BoundingPolygon

```
<gmd:EX_BoundingPolygon
  <gmd:polygon>
    <gml:Polygon gml:id="detailedExtent"
          srsName="http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_2D">
      <gml:exterior>
        <gml:LinearRing>
          <gml:pos>-74.92250 39.10333</gml:pos>
          <gml:pos>-74.92269 39.19386</gml:pos>
          <gml:pos>-74.66167 39.19414</gml:pos>
          <gml:pos>-74.66142 39.10306</gml:pos>
          <gml:pos>-74.92250 39.10333</gml:pos>
        </gml:LinearRing>
      </gml:exterior>
    </gml:Polygon>
  </gmd:polygon>
</gmd:EX_BoundingPolygon>
```

[28] This is a subtle point in that the resource may include content specifying that data is missing or degraded in certain extents (*e.g.,* due to partial/intermittent or total/continuous cloud cover). This is different than the situation where the resource is simply silent (has no content whatsoever) in certain extents. Whereas the latter situation may rationally be reported in metadata as a polygon with one or more interior rings (holes) corresponding to the "silent areas", the former might be better reported as "complete coverage" (no interior rings). The business practice(s) for determining when to report that "we looked but didn't see" need to be determined.

The SMIS specifies the extension object *sdsfie:BoundingPoint* as a means to encode the spatial extent of the resource as a point. An example instance of the use of *sdsfie:BoundingPoint* is illustrated in Figure 37.

Figure 37 – Example instance of sdsfie:BoundingPoint

```
<sdsfie:BoundingPoint
  <sdsfie:point>
    <gml:Point gml:id="extentCentroid"
        srsName="http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_2D">
      <gml:pos>-74.79206 39.14860</gml:pos>
    </gml:Point>
  </sdsfie:point>
</sdsfie:BoundingPoint>
```

The XML element *nas:point* (“point defining the location of the resource”) in Figure 37 functions equivalent to *gmd:polygon* (“sets of points defining the bounding polygon”) in Figure 36, serving to wrap the applicable GML geometry by representing the corresponding UML attribute.

8.3 *Temporal Extent*

Temporal extents reported in ISO 19115-conformant metadata are instantiated in an XML instance document using ISO 19136. Primarily, the temporal extent will be reported as either a closed period (both the beginning and ending times are reported), an open period (only either the beginning or ending times reported) or as an instant (*i.e.,* a date, or a date and time).

The GML objects used to report temporal extent in the SMIS are *gml:TimeInstant* and *gml:TimePeriod*. A closed period uses the *gml:TimePeriod* object with a date and/or time specified for both *gml:begin* (start of the period) and *gml:end* (end of the period). An example instantiation is illustrated in Figure 38.

Figure 38 – Example Temporal Extent as a Closed Period

```
<gmd:EX_TemporalExtent
  <gmd:extent>
    <gml:TimePeriod gml:id="myClosedPeriod">
      <gml:begin>
        <gml:TimeInstant gml:id="myClosedInitiate">
          <gml:timePosition>2007-01-01</gml:timePosition>
        </gml:TimeInstant>
      </gml:begin>

      <gml:end>
        <gml:TimeInstant gml:id="myClosedTerminate">
          <gml:timePosition>2007-01-31</gml:timePosition>
        </gml:TimeInstant>
      </gml:end>
    </gml:TimePeriod>
```

```
  </gmd:extent>
</gmd:EX_TemporalExtent>
```

The content of *gml:timePosition* can express a temporal value in multiple ways. The content model used is an *xs:union* of many simple types. Table 14 lists the supported content of *gml:timePosition* in the SMIS, the corresponding XML schema simple type, and an example of the content corresponding to that simple type.

Table 14 – Supported Date/Time Representations

gml:timePosition Content	XSD Type	Example
Year	xs:gYear	"2007"
Year and Month	xs:gYearMonth	"2007-03"
Date (Year, Month, and Day)	xs:date	"2007-03-20"
Date and Time	xs:dateTime	"2007-03-20T14:27:50Z" "2007-03-20T14:27:50.0Z"

When specifying a time instant a degree of precision should be used that is consistent with applicable business practices.[29] However, in the context of enterprise-wide search it is necessary to ensure that a consistent interpretation of reduced-precision values of *gml:timePosition* is shared. To this end, the following rules shall be observed:

1. The date/times reported for a time period shall be *inclusive* in the period.
2. The reported time shall *always* be based on Universal Time (UTC), indicated by appending the capital letter Z (meaning the "zero meridian") to the time specification.[30]
3. Given a truncated specification of date/time (see Table 14) for the start of the period, it shall be understood that for the year specified the period begins at:
    - the first month of the year when the month is not specified,
    - the first day of the month when the day is not specified,
    - the exact specified time when the fractional seconds are not specified, and
    - 00:00:00.0Z when the time is not specified.
4. Given a truncated specification of date/time (see Table 14) for the end of the period, it shall be understood that for the year specified the period ends at:
    - the last month of the year when the month is not specified,
    - the last day of the month when the day is not specified,
    - the specified time plus 0.9 seconds when the fractional seconds are not specified, and
    - 23:59:59.9Z when the time is not specified.

Rigorous observance of these rules when preparing or using SMIS instance documents will ensure a consistent understanding of temporal extents.

[29] The XML Schema standard requires time be reported as HH:MM:SS.S (hours, minutes and decimal seconds). Even though decimal seconds are thus reported in the metadata instance document, the time may not be known to this degree of precision.

[30] When a time is specified, the XML Schema standard indicates the time zone is non-deterministic if not specified. For this reason, it is recommended that, in general, specified times always indicate the time zone in conformance with the specification of *xs:time*.

An open period may be used to report a temporal extent that covers the time “before” or “since” a known date/time through the use of the optional XML attribute *indeterminatePosition*. This takes a value from an enumeration defined as follows:

- "**unknown**": no specific value for temporal position is provided;
- "**before**": the actual temporal position is unknown, but it is known to be before the specified value; and
- “**after**”: the actual temporal position is unknown, but it is known to be after the specified value.[31]

For example, a resource that contains current data as of a certain date could have its temporal extent reported as an open period. The example instantiation in Figure 39 illustrates the temporal extent matching the statement “on or before January 31, 2007” (or equivalently “no later than January 31, 2007”).

Figure 39 – Example Temporal Extent as an Open Period

```
<gmd:EX_TemporalExtent
  <gmd:extent>
    <gml:TimePeriod gml:id="myOpenPeriod">
      <gml:begin>
        <gml:TimeInstant gml:id="myOpenInitiate">
          <gml:timePosition indeterminatePosition="unknown"/>
        </gml:TimeInstant>
      </gml:begin>

      <gml:end>
        <gml:TimeInstant gml:id="myClosedTerminate">
          <gml:timePosition>2007-01-31</gml:timePosition>
        </gml:TimeInstant>
      </gml:end>
    </gml:TimePeriod>
  </gmd:extent>
</gmd:EX_TemporalExtent>
```

A time instant may be used as the content of a temporal extent in order to indicate a specific date/time. An example instantiation of a time instant (January 10, 2007 at 1800 UTC) is illustrated in Figure 40.

[31] The value “**now**”, indicating the specified value shall be replaced with the current temporal position whenever the value is accessed, shall not be used.

Figure 40 – Example Temporal Extent as an Instant

```
<gmd:EX_TemporalExtent
  <gmd:extent>
    <gml:TimeInstant gml:id="timeStampExample">
      <gml:timePosition>2007-01-10T18:00:00Z</gml:timePosition>
    </gml:TimeInstant>
  </gmd:extent>
</gmd:EX_TemporalExtent>
```

A time instant shall never use the optional XML attribute *indeterminatePosition*; instead an open interval as illustrated in Figure 39 shall be specified.

8.4 *XLink Use*

The ISO/TS 19139 XML schema implementation of ISO 19115 provides the option of encoding information in-line in a metadata instance element or providing a reference to an instance of a metadata element containing the information that is located elsewhere (but typically in the same instance document). This technique uses Xlink (specifically the *xlink:href* attribute) to identify a local or remote instantiation of a metadata element. By using linking, a metadata instance can be more compact with fewer instances of identical information being repeated throughout the document.

One area within resource metadata where this can be of use is when citing a Responsible Party. For example, an instance of *CI_ResponsibleParty* may be created for the point of contact for the resource data (*gmd:pointOfContact*) and then reused when the same party also is the contact for the resource metadata. An example instance is illustrated in Figure 41 where the instance of *gmd:CI_ResponsibleParty* in the second instance of *gmd:pointOfContact* is included by reference in the preceding instance of *gmd:contact*. This ordering was chosen so as to preserve the integrity of the *gmd:identificationInfo* should it later be desired to reuse that metadata section for a different purpose.

Figure 41 – Example Use of xlink:href to Include an Element By Reference

```
<gmd:MD_Metadata
   xmlns:gmd="http://www.isotc211.org/2005/gmd"
   xmlns:gco="http://www.isotc211.org/2005/gco">

  <!-- ... some elements omitted from this illustration -->
  <gmd:contact xlink:href="#ContentResponsibleParty"/>

     <!-- ... some elements omitted from this illustration -->
     <gmd:pointOfContact>
        <gmd:CI_ResponsibleParty id="ContentResponsibleParty">
          <gmd:organisationName>
            <gco:CharacterString>Ft. Sill DPW</gco:CharacterString>
          </gmd:organisationName>
```

```
            <!-- ... some elements omitted from this illustration -->
            <gmd:role>
              <gmd:CI_RoleCode
                   codeList="http://metadata.ces.mil/dse/ns/DISDI/codelist/RoleCode"
                   codeListValue="creator"/>
            </gmd:role>
          </gmd:CI_ResponsibleParty>
        </gmd:pointOfContact>

  <!-- ... some elements omitted from this illustration -->
</gmd:MD_Metadata>
```

8.5 *ISO-associated Anomalies*

8.5.1 PT_Locale

SDSFIE-M profiles ISO 19115:2003/Cor. 1:2006, which specifies the content model of the `PT_Locale` class as including the UML attribute `language`, whose domain is the `<<CodeList>>` `LanguageCode`. This is in accordance with the specification in ISO/TS 19139:2007 of that class.

The ISO/TS 19139 XML schema itself, however, encodes this content model using *gmd:PT_Locale* and the XML element *gmd:language**Code***, whose type is *gmd:LanguageCode_PropertyType* .

Since the SMIS XML exchange schema imports the ISO/TS 19139 XML schema, the XML element used is necessarily *gmd:language**Code***, although it appears differently in SDSFIE-M.

8.5.2 MD_Identifier

ISO 19115 specifies the content model of the `MD_Identifier` class as optionally (“[0..1]”) including the UML attribute `authority`. This optional attribute is inherited to its subclass `RS_Identifier`.

The ISO/TS 19139 XML schema implementation of ISO 19115 encodes `RS_Identifier` as an extension of `MD_Identifier`, thus including the optional XML element *gmd:authority* in the content model of *gmd:RS_Identifier*.

In SDSFIE-M, the content model of the `MD_Identifier` class shall always include the UML attribute `authority`. However this requirement is only intended to apply to uses of the `MD_Identifier` class and not to uses of its `RS_Identifier` subclass.

This design pattern is reflected in the SMIS XML exchange schema by:

1. Leaving the multiplicity of *gmd:authority* in the content model of *gmd:MD_Identifier* unchanged, thus the XML facet *minOccurs* remains zero (and is thus optional).
2. Asserting a Schematron constraint on uses of *gmd:MD_Identifier* in conformant instance documents to require that the *gmd:authority* element have content.
3. Asserting a Schematron constraint on uses of *gmd:RS_Identifier* in conformant instance documents to require that the *gmd:authority* element not be used.

This approach ensures that the conformance criteria of ISO 19115 and ISO/TS 19139 are met while allowing the implementation of `RS_Identifier` to be maximally consistent with that of other SMIS references to Coordinate Reference System (CRS) information resources in the DSE (see Annex B.2.4).

Annex A – Test Suite

(Normative)

A.1 *Introduction*

Conformance with SMIS shall be determined based on the tests specified in this Annex. These tests are accomplished through the use of a validating XML processor and a Schematron validator. In general, these tests are used to determine if an XML instance document is both well-formed (meets syntactic requirements) and valid (meets logical requirements) with respect to the requirements of SMIS, and in the case of an SMIS-conformant application whether it correctly writes and/or reads SMIS-conformant instance documents.

A.2 *Validating XML Processor*

XML Schema 1.0 (Second Edition) describes a class of data objects called “XML documents” and partially describes the behavior of computer programs which process them.

XML documents are made up of storage units called “entities”, which contain either parsed or unparsed data. Parsed data is made up of characters, some of which form character data, and some of which form markup. Markup encodes a description of the document's storage layout and logical structure. XML provides a mechanism to impose constraints on the storage layout and logical structure.

An XML schema is used to describe the structure of an XML document by specifying the valid elements that can occur in a document, the order in which they can occur, and expressing constraints on certain aspects of these elements. These constraints may be as simple as “The Name in an element's end-tag *MUST* match the element type in the start-tag.” and “An element type *MUST NOT* be declared more than once.”, however many are more complex.

An XML schema is intended as a machine-readable mechanism to describe what constitutes a valid XML document according to a particular XML vocabulary. A schema defines what constraints an XML document producer commits to meeting and what expectations an XML document consumer must meet in order to ensure the transmission of that document from producer to consumer results in a complete and faithful data exchange. Typically, the consumer ensures that the XML document being received from the producer conforms to that producer commitment by validating the received document against its specified XML Schema document (XSD).

Usually a general-purpose XML processor is used to read XML documents, providing access to their content and structure; this is typically accomplished on behalf of a specialized application. XML Schema 1.0 (Second Edition) describes the required behavior of that XML processor in terms of how it must read XML data and the information that it must provide to that specialized application. Usually a “validating” XML processor is employed – which is required to examine every component of the XML document and report all well-formedness and validity violations.

A.3 *Schematron Validator*

ISO/IEC 19757-3:2006 defines the Schematron Document Schema Definition Language (DSDL) may be used to specify one or more validation processes to be performed against XML instance documents. Schematron is a rule-based validation language for making assertions (see Annex B.4) about the presence or absence of patterns in XML trees. It is a simple and powerful structural schema language expressed in XML using a small number of elements and XPath (a

query language for selecting nodes from an XML document). It may be employed as an adjunct to the structural validation capabilities of XSD – testing for co-occurrence constraints, non-regular constraints, and inter-document constraints.

Schematron is a language system for specifying and declaring assertions about arbitrary patterns in XML documents, based on the presence or absence, names and values of elements and attributes along paths. It uses the languages of *XML Path Language (XPath) Version 1.0* and *XSL Transformations (XSLT) Version 1.0.*

Considered as a document type, a Schematron schema (*.sch* file) contains natural-language assertions concerning a set of XML documents, marked up with various elements and attributes for testing these natural-language assertions, and for simplifying and grouping assertions.

Considered theoretically, a Schematron schema reduces to a non-chaining rule system whose terms are Boolean functions invoking an external query language on the instance and other visible XML documents, with syntactic features to reduce specification size and to allow efficient implementation.

Considered analytically, Schematron has two characteristic high-level abstractions: the pattern and the phase. These allow the representation of non-regular, non-sequential constraints that ISO/IEC 19757-2:2003 (*Document Schema Definition Languages (DSDL) – Part 2: Regular grammar-based validation – RELAX NG*) cannot specify, and various dynamic or contingent constraints.

A general Schematron validator is a function returning an indication an XML document is "valid", "invalid" or "error". The function notionally performs two steps: transforming the specified Schematron schema into a minimal syntax[32], and then testing the XML document against the minimal syntax. It is common to implement Schematron validators directly using XSLT.

ISO/IEC 19757-3:2006, Annex C Default Query Language Binding specifies that:

> A Schematron schema with no language binding or a `queryBinding` attribute with the value `xslt`, in any mix of upper and lower case letters, shall use the following binding:
>
> - The query language used is the extended version of XPath specified in XSLT. Consequently, the data model used is the data model of those specifications.
> - The rule context is interpreted according to the Production 1 of XSLT. The rule context may be the root node, elements, attributes, comments and processing instructions.
> - The assertion test is interpreted according to Production 14 of XPath, as returning a Boolean value.
> - The name query is interpreted according to Production 14 of XPath, as returning a string value. Typically, the `select` attribute contains an expression returning an element node: the name query takes the local or prefixed name of the node, not its value.
> - The value-of query is interpreted according to Production 14 of XPath, as returning a string value.
> - The let value is interpreted according to Production 14 of XPath, as returning a string value.
> - The notation for signifying the use of parameter of an abstract pattern is to prefix the name token with the '$' character. This is a character not found as a delimiter in URLs or XPaths. The '$' character not followed by the name of an in-scope parameter shall not be treated as a parameter name delimiter. Such a character may subsequently be used as a delimiter for a variable name or as a literal character.

[32] This process: resolves all inclusions by replacing the `include` element by the resource to which it links; resolves all abstract patterns by replacing parameter references with actual parameter values in all enclosed attributes that contain queries; resolves all abstract rules in the schema by replacing the `extends` elements with the contents of the abstract rule identified; negates all `report` elements into `assert` elements; and, removes elements used for diagnostics and documentation.

- A Schematron let expression is treated as an XSLT variable. The XSLT '$' delimiter signifies the use of a variable in a context expression, assertion test, name query, value-of query or let expression. The '$' character not followed by the name of an in-scope variable shall be treated as a literal character.

The XSLT `key` element may be used, in the XSLT namespace, before the pattern elements.

The attributes `id`, `name` and `prefix` should follow the rules for non-colonized names for the version of XML used by the document.

While the ISO/IEC 19757-3:2006 Default Query Language Binding uses XSLT 1.0, other Query Language Bindings may be employed.

Schematron validators used in testing SMIS conformance shall use the default Query Language Binding of XSLT 1.0.

In the future it may be the case that *XSL Transformations (XSLT) Version 2.0* (http://www.w3.org/TR/xslt20/) may be allowed for use in testing SMIS conformance, based on the publication of ISO/IEC 19757-3 Second Edition.

A.4 *Conformance*

A.4.1 Metadata Instance Document

SMIS conformance of an XML instance document requires the following set of conditions be met; in general these tests will be applied in the sequence specified.

1. The XML instance document, when evaluated against ***smis.xsd*** and the specified DSE-based imported schema resources using a validating XML processor, shall be determined to be **well-formed** in accordance with the XML Schema 1.0 (Second Edition) standard.
2. The XML instance document, when evaluated against ***smis.xsd*** and the specified DSE-based imported schema resources using a validating XML processor, shall be determined to be **valid** in accordance with the XML Schema 1.0 (Second Edition) standard. This test ensures the document meets the conformance requirements of ISO/TS 19139.
3. The XML instance document, when evaluated against ***smisGmd.sch*** using a Schematron validator conforming to the requirements of ISO/IEC 19757-3:2006, shall be determined to be **valid**. This test ensures the document satisfies all constraints specified by ISO/TS 19139 that cannot be enforced using XSD.
4. The XML instance document, when evaluated against ***smisGmdProfileExclude.sch*** using a Schematron validator conforming to the requirements of ISO/IEC 19757-3:2006, shall be determined to be **valid**. This test ensures the document does not use elements from ISO/TS 19139 that are excluded from SDSFIE-M.
5. The XML instance document, when evaluated against ***smisGmdProfileRestrict.sch*** using a Schematron validator conforming to the requirements of ISO/IEC 19757-3:2006, shall be determined to be **valid**. This test ensures that when the document uses elements from ISO/TS 19139 their use is restricted in accordance with the requirements of SDSFIE-M.
6. The XML instance document, when evaluated against ***smis.sch*** using a Schematron validator conforming to the requirements of ISO/IEC 19757-3:2006, shall be determined to be **valid**. This test ensures that when the document uses ISO/TS 19139-extension elements, their use is restricted in accordance with the requirements of SDSFIE-M.

The files *smisGmdProfile.xsd* and *smisGmiProfile.xsd* shall not be used for the purposes of validation.

A.4.2 Metadata Document Generation

All XML instance documents generated by the system under test are intended to be SMIS-conformant shall satisfy the set of conditions specified in Annex A.4.1.

A.4.3 Metadata Document Consumption

The system under test shall demonstrate it successfully and “meaningfully” extracts all component values of any XML instance document that has been demonstrated to be SMIS-conformant, as determined by the set of conditions specified in Annex A.4.1.

Annex B – Conventions

(Normative)

B.1 *Naming and Design Rules*

B.1.1 Introduction

The SMIS XML Schema is an ISO 19106-conformant Class 2 Profile of ISO/TS 19139. This SMIS encoding will typically be used “stand-alone”, however it is specifically intended to eventually integrate with the SDSFIE Online tools.

Where not in conflict with the requirements of ISO/TS 19139, the SMIS XML Schema follows the applicable naming and design rules from GML such that users of the SMIS schema may create GML-based application schemas when appropriate.

B.1.2 Lexical Conventions

The GML schema follows several lexical conventions for the names of elements and complex types to assist in human comprehension of GML instance documents and schemas. These lexical conventions are as follows:

- Objects are instantiated as XML elements with a conceptually meaningful name in UpperCamelCase.[33]
- Properties are instantiated as XML elements whose name is in lowerCamelCase.
- Abstract elements have a prefix “Abstract” (objects) or “abstract” (properties) prepended to their name.
- Names of XML Schema complex types are in UpperCamelCase ending in the word “Type”.
- Abstract XML Schema complex types have the word “Abstract” prepended.

These lexical conventions are followed in this SMIS standard.

While both ISO 19136:2007 (GML) and by ISO/TS 19103:2005 *Geographic information – Conceptual schema language* are ambiguous regarding the recommended approach to the naming of enumeration and code list literals, ISO/DIS 19103 (Draft International Standard, Second Edition) states that “Enumerated types are modeled as classifiers with attributes representing the allowed values; these attributes shall follow the naming conventions for regular attribute names and should be mnemonic.” Therefore this standard follows the lowerCamelCase convention for naming the literal values of enumerations and code lists.

B.1.3 XML Schema Conventions

The GML schema consists of W3C XML Schema components that define types and declares:

- XML elements to encode GML objects with identity,

[33] UpperCamelCase is a naming convention in which a name is formed of multiple words joined together as a single word with the first letter of each of the multiple words capitalized within the new word that forms the name; lowerCamelCase is a variation in which the first letter of the new word is lower case, allowing it to be easily distinguished from an UpperCamelCase name.

- XML elements to encode GML properties of those objects, and
- XML attributes qualifying those properties.

The GML schema, and any profile of the GML schema, is constrained as follows:

- A GML object is an XML element of a type derived directly or indirectly from `gml:AbstractGMLType`. From this derivation, a GML object shall have a `gml:id` attribute.
- A GML property shall not be derived from `gml:AbstractGMLType`, shall not have a `gml:id` attribute, and shall not have any other attribute of XML type `ID`.
- An element is a GML property if and only if it is a child element of a GML object.
- A GML object shall not appear as the immediate child of a GML object.
- Consequently, no element may be both a GML object and a GML property.
- All XML attributes declared in the GML schema are defined without namespace, the only exception is the `gml:id` XML attribute.
- The use of additional XML attributes in a GML profile (and GML application schemas) is discouraged.

These XML Schema conventions are followed, where applicable and not in conflict with the rules of ISO/TS 19139, in this SMIS standard.

B.2 *Information Resources*

B.2.1 Introduction

The DoD Data Services Environment (DSE) may be used to ensure the persistence of a variety of information resources (*e.g.,* XSD files). Each information resource may be bound to a unique URL that provides both identity for that resource and access to that resource. Through replication, the DSE provides a mechanism for making information resources available for DoD/IC users in environments where a copy of the DSE is available but direct access to the Internet is not (*e.g.,* in DIL (Disconnected, Intermittent, or Low-bandwidth) situations, including secure enclaves).

In support of the IGI&S community, the Defense Installation Spatial Data Infrastructure Program (DISDI) maintains multiple information resources in the DSE. The management of DSE-provisioned information resources is accomplished through mechanisms established in governance namespaces by their managers. The DISDI Governance Namespace in the DSE is governed at two levels of granularity: *schemas* (and related documents) and *schema items* (*e.g.*, elements, datatypes, and datatype domain values).

Annex sections B.2.2, B.2.3 and B.2.4 describe some aspects of schema item-level governance.

B.2.2 Code List Resources

B.2.2.1 Fixed Enumerations

The values of domains whose allowed values can be completely listed are termed **enumerations** and may be established both as sets and as (contained) individual domain value

items. *XML Schema Part 2: Datatypes (Second Edition),* W3C Recommendation 28 October 2004, Section 4.3.5 specifies the characteristics of this encoding as follows:[34]

> [Definition:] **enumeration** constrains the ·value space· of a specified set of values. **enumeration** does not impose an order relation on the ·value space· it creates; the value of the ·ordered· property of the ·derived · datatype remains that of the datatype from which it is ·derived·.
>
> ·enumeration· provides for:
>
> Constraining a ·value space· to a specified set of values.
>
> The following example is a datatype definition for a ·user-derived· datatype which limits the values of dates to the three US holidays enumerated. This datatype definition would appear in a schema authored by an "end-user" and shows how to define a datatype by enumerating the values in its ·value space· The enumerated values must be type-valid literals for the ·base type·.

```
<simpleType name='holidays'>
    <annotation>
        <documentation>some US holidays</documentation>
    </annotation>
    <restriction base='gMonthDay'>
      <enumeration value='--01-01'>
        <annotation>
            <documentation>New Year's day</documentation>
        </annotation>
      </enumeration>
      <enumeration value='--07-04'>
        <annotation>
            <documentation>4th of July</documentation>
        </annotation>
      </enumeration>
      <enumeration value='--12-25'>
        <annotation>
            <documentation>Christmas</documentation>
        </annotation>
      </enumeration>
    </restriction>
</simpleType>
```

There exist enumeration datatypes whose listed domain values are subject to change, evolving over time as new values are added and old values are either retired or superseded by new values; *e.g.*, country names (renaming of “Burma” to the “Union of Myanmar”, or the retirement of the name “Union of Soviet Socialist Republics”). The rate of change may be relatively slow (*e.g.,* the set of country names) or relatively fast (*e.g.*, the set of Earth-imaging satellites).

[34] Note enumeration is a constraining facet that may be applied to a number of primitive types. In the SMIS schema it is principally used with the **`xsd:string`** type.

Revising the domain of an enumeration datatype requires publishing a new version of the schema since it constitutes a revision to a schema-specified type.

B.2.2.2 Flexible Enumerations

For relatively quickly changing enumerations it can become onerous to have to publish a new version of a schema whenever the set of domain values has changed. In these cases it is valuable to replace an enumeration by a code list. A **code list** is a flexible enumeration that specifies an unambiguous identifier using a consistent representation for each member in a set of domain values (*e.g.,* country codes or units of measure). A code list can be used to specify an open enumeration and should be used if only the *likely* or an *initial set* of allowed values are known at schema-creation time.

When a code list value is instantiated in an XML instance document, two identifiers are provided – *codeList* and *codeListValue*:

- The *codeList* specifies a remote resource in which the code list domain is defined.
- The *codeListValue* is the coded value from the specified (remote resource code list) domain that encodes the concept intended (denoted) in the XML instance document.

Figure 42 illustrates a use of such a code list value in an XML instance document, while Figure 43 illustrates the alternative (traditional) use of an enumeration value.

Figure 42 – Example Codelist Instance Document Fragment

```
<ns:Container xmlns:ns="http://metadata.ces.mil/dse/ns/DISDI/myNameSpace">
  <!-- some elements omitted from this illustration -->

  <CountryCode
    codeList="http://metadata.ces.mil/dse/ns/DISDI/codelist/GENC-digraph"
    codeListValue="FR"/>

  <!-- some elements omitted from this illustration -->
</ns:Container>
```

Figure 43 – Example Enumeration Instance Document Fragment

```
<ns:Container xmlns:ns="http://metadata.ces.mil/dse/ns/DISDI/myNameSpace">
  <!-- some elements omitted from this illustration -->

  <CountryCode>FR</CountryCode>

  <!-- some elements omitted from this illustration -->
</ns:Container>
```

B.2.2.3 Managed Code Lists

The SMIS XML Schema employs managed code lists. The NCGIS maintains a set of code list information resources in the DSE. They may be accessed at either:

http://metadata.ces.mil/dse/ns/GPAS/codelist/

http://metadata.ces.mil/dse/ns/GSIP/codelist/

The DISDI Program maintains a set of code list information resources in the DSE. They may be accessed at either:

http://metadata.ces.mil/dse/ns/DISDI/codelist/

XML instance documents conformant to the SMIS shall only use those code lists registered in these components of the DISDI, GPAS and GSIP Governance Namespaces in the DSE.

Registered code lists are identified by URIs composed from the **~/codelist/** base URL plus a short code list-specific identifier. For example, in the case of the Role Code (profiled from ISO 19115), this identification is by the URI:

http://metadata.ces.mil/dse/ns/DISDI/codelist/RoleCode

Each such URI has a corresponding code list-specific accessible information resource – an ISO 19136-conformant instance document.

B.2.2.4 Code List Item References

The DISDI Program maintains a set of code list item (enumerant) information resources in the DSE. They may be accessed at:

http://metadata.ces.mil/dse/ns/DISDI/codelist/*[...]*/

For example, the SMIS XML Schema employs the set of code lists specified in Table 11. They are identified URIs such as:

http://metadata.ces.mil/dse/ns/DISDI/codelist/CharacterSetCode

http://metadata.ces.mil/dse/ns/DISDI/codelist/GENC-trigraph

Registered code list item values are identified by URIs composed from the appropriate **~/codelist/*[...]*/** base URL plus the code list-type identifier plus a short code list-specific item (enumerant) identifier. The code list-type identifier and enumerant-specific identifier correspond, respectively, to a *codeList* and a *codeListValue* as specified in Annex B.2.2.2. The *codeListValue* values for code list items (enumerants) are specified in accordance with the lowerCamelCase convention (see Annex B.1).

For example, in the case of the “utf8” and “USA” code list items (enumerants) of the Character Set Code and ISO 3166-1 Trigraph Country Codes code lists, these identifications are by the URIs:

http://metadata.ces.mil/dse/ns/DISDI/codelist/CharacterSetCode/utf8

http://metadata.ces.mil/dse/ns/DISDI/codelist/GENC-trigraph/USA

Each such URI has a corresponding code list-specific accessible information resource – an ISO 19136-conformant instance document.

XML instance documents conformant to the SMIS shall only use those code list values registered in these components of the DISDI, GPAS and GSIP Governance Namespaces in the DSE.

B.2.3 Unit of Measure Resources

B.2.3.1 Introduction

Measures are employed in both metadata and data resources to characterize the values of properties. A measure is the result of performing the act or process of ascertaining the extent, dimensions, or quantity of some entity. A measure has an accompanying “unit” that is a

reference quantity chosen from a category of mutually comparable physical quantities, *e.g.,* second (time category), metre (length category), or kilogram (mass category).

The SMIS supports the standardized units of measure specified by the multi-part ISO 80000 *Quantities and Units* (also known as the International System of Units (SI)) in conjunction with the conceptual schema for measures specified by ISO/TS 19103:2005 *Geographic information – Conceptual schema language*. Non-standard "conventional" units of measure are also supported (*e.g.,* English Units, Imperial units, and U.S. customary units), as required.

B.2.3.2 Radix Point Presentation

In specifying the presentation of numeric quantities having fractional parts this standard recognizes international variation in the presentation of the radix point. The radix point is the symbol used in numerical representations to separate the integral part of the number (to the left of the radix) from its fractional part (to the right of the radix).

The radix point mark is usually presented as a small dot, either placed on the baseline or halfway between the baseline and the top of the numerals. In base-10, the radix point is more commonly known as the "decimal point"; radix point, however, is the more general term used for other bases. In many non-English speaking countries, a comma ',' is used instead of a period '.' as the radix point mark.

This standard always uses the period '.' as the radix point mark, however the schema implementation allows for other choices.

B.2.3.3 SI Prefixes

The SMIS adopts the SI nomenclature for prefixing units of measure with standardized decimal multiples and submultiples. SI prefixes are used to reduce the number of zeros shown in numerical quantities. For example, one-thousandth of an arc degree (a planar angle) can be written as 0.001 arc degree. Using an SI prefix, this is equivalent to 1 arc millidegree.

This standard extends SI prefixes in order to define a consistent notation for the naming of XML elements and types; the applicable SI and extended-SI prefixes are listed in Table 15.

Table 15 – Unit of Measure Prefixes

Name	Multiple	Description	Note
mega	10^6	1,000,000	
hectokilo	10^5	100,000	*Extended from SI*
decakilo	10^4	10,000	*Extended from SI*
kilo	10^3	1,000	
hecto	10^2	100	
deca	10^1	10	
uni	10^0	1	
deci	10^{-1}	0.1	
centi	10^{-2}	0.01	
milli	10^{-3}	0.001	
decimilli	10^{-4}	0.0001	*Extended from SI*
centimilli	10^{-5}	0.00001	*Extended from SI*
micro	10^{-6}	0.000001	

In specifying members of categories of mutually comparable physical quantities (*e.g.,* length) the SMIS includes not only base units (*e.g.,* metre and foot) but also prefixed-units (*e.g.,* kilometre, millimetre and kilofoot).

B.2.3.4 Measures and Units of Measure

ISO 19136:2007 (GML) specifies the `gml:MeasureType` to support recording an amount encoded as a value of XML Schema **`xsd:double`**, together with a unit of measure indicated by an XML attribute `uom` – short for "unit of measure". The value of the `uom` attribute identifies a reference system for the amount, usually a ratio or interval scale.

The complex type `gml:MeasureType` is defined as follows:

```
<complexType name="MeasureType">
  <simpleContent>
    <extension base="double">
      <attribute name="uom" type="gml:UomIdentifier" use="required"/>
    </extension>
  </simpleContent>
</complexType>
```

For example, an XML schema may contain an element declaration using this type:

```
<element name="height" type="gml:MeasureType"/>
```

Elements corresponding to this might appear in an XML instance document as follows:

```
<height uom="m">1.4224</height>
<height uom="http://www.equestrian.org/units/hands">14</height>
```

In each case the value of the XMl attribute `uom` identifies either the unit of measure directly or a resource that defines the unit of measure.

The simple type `gml:UomIdentifer` defines the syntax and value space of the unit of measure identifier. This is a union type defined as follows:

```
<simpleType name="UomIdentifier">
  <union memberTypes="gml:UomSymbol gml:UomURI"/>
</simpleType>
```

The first member of the union type, `gml:UomSymbol`, is defined as follows:

```
<simpleType name="UomSymbol">
   <restriction base="string">
    <pattern value="[^: \n\r\t]+"/>
  </restriction>
</simpleType>
```

This type specifies a character string of length at least one, and restricted such that it must not contain any of the following characters: ":" (colon), " " (space), (new line), (carriage return), and (tab). This allows values corresponding to familiar abbreviations, such as "kg", "m/s", *etc*.

The second member of the union type, `gml:UomURI`, is defined as follows:

```
<simpleType name="UomURI">
```

```
    <restriction base="anyURI">
      <pattern value="([a-zA-Z][a-zA-Z0-9\-\+\.]*:|\.\./|\./|#).*"/>
    </restriction>
  </simpleType>
```

This type specifies a URI, restricted such that it must start with one of the following sequences: "#", "./", "../", or a string of characters followed by a ":".[35] These patterns ensure the most common URI forms are supported, including absolute and relative URIs and URIs that are simple fragment identifiers, but prohibit certain forms of relative URI that could be mistaken for unit of measure symbol, *e.g.*, "m/s".[36]

In an instance document, on elements of type `gml:MeasureType` the mandatory XML attribute `uom` shall carry a value corresponding to either:

- a conventional unit of measure symbol; or
- a link to a definition of a unit of measure that does not have a conventional symbol, or when it is desired to indicate a precise or variant definition.

For the latter purpose, units of measure dictionaries may be established based on appropriate GML components.

B.2.3.5 Unit of Measure Dictionaries

In accordance with ISO 19136:2007 (GML) Clause 16.2 *Units schema*, units of measure may be unambiguously specified, their relationships and conversion factors documented (where appropriate), and dictionaries of units of measure established.

Figure 44 illustrates a use of the GML units schema to establish a hypothetical GML dictionary (see ISO 19136:2007 Clause 15.2 *Dictionary schema*) corresponding to the base and derived units defined by ISO 80000 *Quantities and Units*, plus a selection of conventional units to illustrate the usage of these GML components.

Figure 44 – Example GML Units of Measure Dictionary

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet href="../gmlDictionary.xsl" type="text/xsl"?>
<gml:Dictionary
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xsi:schemaLocation="http://www.opengis.net/gml/3.2
        http://metadata.ces.mil/dse/ns/GPAS/schemas/ogc/gml/3.2.1/gml.xsd"
  gml:id="LengthQuantity">

  <gml:description>A collection of units of measure for the physical quantity "length".</gml:description>
  <gml:identifier codeSpace="http://metadata.ces.mil/dse/ns/GSIP/uom">length</gml:identifier>
```

[35] An optional fragment-identifier, preceded by "#", may appear within a URI reference. The part of the reference before the "#" indirectly identifies a resource, and the fragment identifier identifies some portion of that resource.

[36] Note it is possible to re-write such a relative URI to conform to the restriction (*e.g.* "./m/s").

```
  <gml:name>DoD/IC Dictionary: Length Units of Measure</gml:name>
  <gml:remarks>Length is the quantity of a linear extent.</gml:remarks>

  <gml:dictionaryEntry>
        <!--================ Base Units ===============-->
    <gml:Dictionary gml:id="BaseUomDictionary">
      <gml:description>The quantity "length" base unit of measure in the SI units system.</gml:description>
      <gml:identifier
          codeSpace="http://metadata.ces.mil/dse/ns/GSIP/uom">LengthBaseUom</gml:identifier>
      <gml:name>SI Base Unit</gml:name>
      <gml:dictionaryEntry>
        <gml:BaseUnit gml:id="metre">
        <gml:description>The base unit in SI for the physical quantity "length", defined as the length of the path travelled by light in vacuum during a time interval of 1/299,792,458 of a second.</gml:description>
        <gml:identifier
            codeSpace="http://metadata.ces.mil/dse/ns/GSIP/uom/length">metre</gml:identifier>
        <gml:name>Metre</gml:name>
        <gml:quantityType>Length</gml:quantityType>
        <gml:catalogSymbol
            codeSpace="http://www.bipm.fr/en/si">m</gml:catalogSymbol>
        <gml:unitsSystem xlink:href="http://www.bipm.fr/en/si"/>
       </gml:BaseUnit>
      </gml:dictionaryEntry>
    </gml:Dictionary>
  </gml:dictionaryEntry>

  <gml:dictionaryEntry>
        <!--============== Conventional Units ==========-->
    <gml:Dictionary gml:id="ConventionalUomDictionary">
      <gml:description>A collection of length-related conventional units of measure which are either widely used or important within a specific community.  For most of these there is either: (1) a known derivation from more primitive units, which may or may not be SI base units; or (2) a known conversion to a preferred unit, which may or may not be an SI Base or Derived unit, through rescaling and offset, or both.</gml:description>
      <gml:identifier codeSpace="http://metadata.ces.mil/dse/ns/GSIP/uom">LengthConventionalUom</gml:identifier>
      <gml:name>Conventional Units</gml:name>
      <gml:dictionaryEntry>
        <gml:ConventionalUnit gml:id="kilometre">
        <gml:description>A conventional unit of measurement of length equal to 1,000.0 metres.</gml:description>
        <gml:identifier
      codeSpace="http://metadata.ces.mil/dse/ns/GSIP/uom/length">kilometre</gml:identifier>
        <gml:name>Kilometre</gml:name>
        <gml:quantityType>Length</gml:quantityType>
        <gml:catalogSymbol>km</gml:catalogSymbol>
        <gml:conversionToPreferredUnit
            uom="http://metadata.ces.mil/dse/ns/GSIP/uom/length/metre">
```

```
          <gml:factor>1.0e3</gml:factor>
        </gml:conversionToPreferredUnit>
      </gml:ConventionalUnit>
    </gml:dictionaryEntry>

  <!-- further content omitted -->
  </gml:Dictionary>
 </gml:dictionaryEntry>

  <!-- further content omitted -->
</gml:Dictionary>
```

B.2.3.6 Unit of Measure References

The NCGIS maintains a set of units of measure (UoM) information resources in the DSE. They may be accessed at:

http://metadata.ces.mil/dse/ns/GSIP/uom/

XML instance documents conformant to the SMIS shall only use those UoM registered in this component of the GSIP Governance Namespace in the DSE.

In an SMIS instance document, on elements of type (or derived from type) `gml:MeasureType` the mandatory `uom` attribute shall carry a value (`gml:UomURI`) corresponding to a URI identifying a registered unit of measure.

That URI is an identifier of a reference quantity chosen from a category of mutually comparable physical quantities. Each such category is established as a separate DSE resource and associated GML units of measure dictionary, for example:

length/	length quantities (*e.g.,* “metre”, “foot”, “fathom”, “nauticalMile”)
area/	area quantities (*e.g.,* “squareMetre”, “squareFoot”)
volume/	volume quantities (*e.g.,* “cubicMetre”, “liter”, “usGallon”)
planeAngle/	plane angle quantities (*e.g.,* “radian”, “arcDegree”, “grad”)
speed/	speed quantities (*e.g.,* “metrePerSecond”, “milePerHour”)
time/	time quantities (*e.g.,* “second”, “minute”, “hour”, “day”)
pureNumber/	pure number quantities (*e.g.,* “unitless”, “percent”, “deciMachNumber”)

In addition, there is a separate DSE resource (and associated GML units of measure dictionary) for those units of measure that are not a member of any category of mutually comparable physical quantities:

noncomparable/	non-comparable physical quantities (*e.g.,* “flightLevel”)

Registered UoM are identified by URIs composed from the **~/GSIP/uom/** base URL plus the quantity-type identifier plus a short UoM-specific identifier. The quantity-type identifier and UoM-specific identifier correspond, respectively, to a *codeList* and a *codeListValue* as specified in Annex B.2.2.2. The *codeListValue* values for UoM are specified in accordance with the lowerCamelCase convention (see Annex B.1).

In the case of the “metre” unit of measure, this identification is by the URI:

http://metadata.ces.mil/dse/ns/GSIP/uom/length/metre

Each such URI has a corresponding UoM-specific accessible information resource – an ISO 19136-conformant instance document.

Specification of UoM "by reference" in the DSE-hosted units of measure information resource allows for dynamic support for units of measure independent of evolution of the SMIS itself. It ensures UoM in GML-based XML instance documents can be validated against type-specific sets of comparable physical quantities (*e.g.,* the employment of only a registered "length" UoM, thus excluding the erroneous use of the "arcDegree" UoM). Schematron assertions (see Annex B.4) may be used to assert additional constraints on the allowed values of UoM for individual measures in a domain-specific schema.

Specification of UoM "by reference" also supports unambiguous documentation of the exact relationships among units of measure in the same category of comparable physical quantities and accordingly the exact conversion of quantity values specified in accordance with different units of measure. It does so without imposing unnecessary burden on XML instance documents.

B.2.4 Coordinate Reference System Resources

The NCGIS maintains a set of Coordinate Reference System (CRS) information resources in the DSE. They may be accessed at:

http://metadata.ces.mil/dse/ns/GSIP/crs/

XML instance documents conformant to the SMIS shall only use those CRS registered in this component of the GSIP Governance Namespace in the DSE.

Registered CRS are identified by URIs composed from the **~/GSIP/crs/** base URL plus a short CRS-specific identifier. For example, in the case of the World Geodetic System 1984 - Geographic, 2-Dimensional CRS, this identification is by the URI:

http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_2D

Each such URI has a corresponding CRS-specific accessible information resource – an ISO 19136-conformant instance document.

The DSE information resource encodes this structure and CRS-specific values as an XML instance document using XML elements and types specified in ISO 19136:2007 (GML) Clause 12.3 *Coordinate reference systems*. Figure 45 illustrates the resulting registered specification for this commonly-used CRS.

Figure 45 – WGS84E_2D CRS Specification

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet href="crsViewer.xsl" type="text/xsl"?>

<gml:GeodeticCRS gml:id="WGS84E_2D"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:gco="http://www.isotc211.org/2005/gco"
  xmlns:gmd="http://www.isotc211.org/2005/gmd"
  xmlns:gml="http://www.opengis.net/gml/3.2">

  <gml:identifier codeSpace="http://metadata.ces.mil/dse/ns/GSIP/crs">WGS84E_2D</gml:identifier>
  <gml:name>World Geodetic System 1984 - Geographic, 2-Dimensional</gml:name>
  <gml:remarks>Since its establishment for epoch 1984, additional higher accuracy reference frame realizations have been
established based on specific Global Positioning System (GPS) weeks (for example: Week 873, denoted as 'G873'); these
revised realizations of the reference frame are generally only important to applications requiring centimetre-level horizontal
positioning accuracy.</gml:remarks>
```

```
  <gml:domainOfValidity>
    <gmd:EX_Extent>
      <gmd:description>
        <gco:CharacterString>Earth (Global)</gco:CharacterString>
      </gmd:description>
    </gmd:EX_Extent>
  </gml:domainOfValidity>
  <gml:scope>Whole Earth; used for horizontal positioning.</gml:scope>

  <gml:ellipsoidalCS>
    <gml:EllipsoidalCS gml:id="EllipsoidalCS_2D">
      <gml:identifier codeSpace="http://metadata.ces.mil/dse/ns/GSIP/crs">EllipsoidalCS_2D</gml:identifier>
      <gml:axis>
        <gml:CoordinateSystemAxis uom="http://metadata.ces.mil/dse/ns/GSIP/uom/arcDegree"
gml:id="geodeticLatitude">
          <gml:identifier codeSpace="http://metadata.ces.mil/dse/ns/GSIP/term">geodeticLatitude</gml:identifier>
          <gml:remarks> The axis direction is positive towards the pole about which the Earth rotates in a counter-clockwise
direction.</gml:remarks>
                <!-- Symbol is small Greek phi. -->
          <gml:axisAbbrev>Lat</gml:axisAbbrev>
          <gml:axisDirection codeSpace="http://metadata.ces.mil/dse/ns/GSIP/term"
          >north</gml:axisDirection>
        </gml:CoordinateSystemAxis>
      </gml:axis>
      <gml:axis>
        <gml:CoordinateSystemAxis uom="http://metadata.ces.mil/dse/ns/GSIP/uom/arcDegree"
gml:id="geodeticLongitude">
          <gml:identifier codeSpace="http://metadata.ces.mil/dse/ns/GSIP/term">geodeticLongitude</gml:identifier>
          <gml:remarks> The axis direction is positive in the direction of the Earth's rotation. </gml:remarks>
          <!-- Symbol is small Greek lambda. -->
          <gml:axisAbbrev>Lon</gml:axisAbbrev>
          <gml:axisDirection codeSpace="http://metadata.ces.mil/dse/ns/GSIP/term"
          >east</gml:axisDirection>
        </gml:CoordinateSystemAxis>
      </gml:axis>
    </gml:EllipsoidalCS>
  </gml:ellipsoidalCS>

  <gml:geodeticDatum>
    <gml:GeodeticDatum gml:id="WGS84_Datum">
      <gml:identifier codeSpace="http://metadata.ces.mil/dse/ns/GSIP/crs">WGS84_Datum</gml:identifier>
      <gml:name>World Geodetic System 1984</gml:name>
      <gml:remarks>This datum is defined by Department of Defense World Geodetic System 1984 - Its Definition and
Relationships with Local Geodetic Systems, NIMA TR8350.2, Third Edition, Amendment 1, 2000-01-03.</gml:remarks>
      <gml:scope>Earth (Global)</gml:scope>
```

```
    <gml:primeMeridian>
     <gml:PrimeMeridian gml:id="Greenwich">
      <gml:identifier codeSpace="http://metadata.ces.mil/dse/ns/GSIP/crs">Greenwich</gml:identifier>
      <gml:name>Greenwich</gml:name>
      <gml:greenwichLongitude uom="http://metadata.ces.mil/dse/ns/GSIP/uom/arcDegree"
      >0</gml:greenwichLongitude>
     </gml:PrimeMeridian>
    </gml:primeMeridian>
    <gml:ellipsoid>
     <gml:Ellipsoid gml:id="WGS84_Ellipsoid">
      <gml:identifier codeSpace="http://metadata.ces.mil/dse/ns/GSIP/crs">WGS84_Ellipsoid</gml:identifier>
      <gml:semiMajorAxis uom="http://metadata.ces.mil/dse/ns/GSIP/uom/metre">6378137.0</gml:semiMajorAxis>
      <gml:secondDefiningParameter>
       <gml:SecondDefiningParameter>
        <gml:inverseFlattening
uom="http://metadata.ces.mil/dse/ns/GSIP/uom/unitless“>298.257223563</gml:inverseFlattening>
       </gml:SecondDefiningParameter>
      </gml:secondDefiningParameter>
     </gml:Ellipsoid>
    </gml:ellipsoid>
   </gml:GeodeticDatum>
  </gml:geodeticDatum>

</gml:GeodeticCRS>
```

Specification of CRS “by reference” in the DSE-hosted CRS information resource(s) allows for dynamic support for CRS independent of evolution of the SMIS schema itself. It also avoids the overhead of exchanging CRS specification(s) as part of individual SMIS instance documents by instead promulgating “well-known CRS identifiers”(and their specifications) in the DoD/IC. Both the DoD Discovery Metadata Specification (DDMS) and Universal Core (UCore) employ this mechanism.

B.3 *Void Values*

ISO 19136:2007 (GML) specifies a mechanism to support content models that require (or allow) recording of an explanation for a void value or other exception. The simple type `gml:NilReasonType` is defined as follows:

```
   <simpleType name="NilReasonEnumeration">
    <union>
     <simpleType>
      <restriction base="string">
       <enumeration value="inapplicable"/>
       <enumeration value="missing"/>
       <enumeration value="template"/>
       <enumeration value="unknown"/>
```

```
    <enumeration value="withheld"/>
   </restriction>
  </simpleType>
  <simpleType>
   <restriction base="string">
    <pattern value="other:\w{2,}"/>
   </restriction>
  </simpleType>
 </union>
</simpleType>

<simpleType name="NilReasonType">
 <union memberTypes="gml:NilReasonEnumeration anyURI"/>
</simpleType>
```

The semantics of the enumerated values of `gml:NilReasonType` are as follows:

- "**inapplicable**": there is no value;
- "**missing**": the correct value is not readily available to the sender of this data. – furthermore, a correct value may not exist;
- "**template**": the value will be available later;
- "**unknown**": the correct value is not known to, and not computable by, the sender of this data – however, a correct value probably exists;
- "**withheld**": the value is not divulged;
- "**other:**"**+text**: other brief explanation, where text is a string of two or more characters with no included spaces; and
- **anyURI**: should refer to a resource which describes the reason for the exception.

A particular community may choose to assign more detailed semantics to the standard values provided. Alternatively, the URI method enables a specific or more complete explanation for the absence of a value to be provided elsewhere and indicated “by reference” in an instance document.

`gml:NilReasonType` may be used as a member of a union in a simple content type where it is necessary to permit a value from the `NilReasonType` union as an alternative to the primary type.

The XML Schema attribute `nillable` may be included in any element declaration within a schema. By default the schema attribute `nillable` has a value of “`false`”. By declaring an element as nillable (`nillable` ="`true`"), an instance of that element may omit its content in cases where an empty value would normally not be schema valid by supplying an attribute `nil` from the XML Schema Instance namespace with the value “`true`”.

In some situations where it is required to declare an element in an application schema nillable, it may be convenient to also add an attribute of type `gml:NilReasonType`. For example:

```
<element name="amount" nillable="true">
 <complexType>
```

```
    <simpleContent>
     <extension base="double">
      <attribute name="nilReason" type="gml:NilReasonType"/>
     </extension>
    </simpleContent>
   </complexType>
  </element>
```

would allow the instances to be augmented with an additional attribute explaining the absence of a value,[37] such as:

```
<amount xsi:nil="true" nilReason="unknown"/>
```

B.4 *Data Validation*

ISO/IEC 19757-3:2006 defines the Schematron Document Schema Definition Language (DSDL) used to specify one or more validation processes to be performed against XML instance documents. Schematron is a rule-based validation language for making assertions about the presence or absence of patterns in XML trees. It is a simple and powerful structural schema language expressed in XML using a small number of elements and XPath (a query language for selecting nodes from an XML document). It may be employed as an adjunct to the structural validation capabilities of XSD – testing for co-occurrence constraints, non-regular constraints, and inter-document constraints.

The W3C XML Schema recommendations allow applications to extend schema validation by adding application specific data in `appinfo` elements within the `annotation` of a particular schema element. One can embed `sch:pattern` elements within these extension blocks, which can then be applied as part of the schema validation process. Namespaces that are used by patterns are declared in an `annotation` at the top level of the schema using *ns* elements.

An example of an embedded Schematron validation pattern is illustrated in Figure 46, where a test has been added to ensure only one of three `srsName` XML attribute values may occur in instance documents containing the hypothetical element “MyLocation”.

Figure 46 – Example inclusion of a Schematron Pattern Element in an XSD

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:mns="http://metadata.ces.mil/dse/ns/DISDI/MyNameSpace"
  xmlns:sch="http://purl.oclc.org/dsdl/schematron"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  targetNamespace="http://metadata.ces.mil/dse/ns/DISDI/MyNameSpace"
  elementFormDefault="qualified" attributeFormDefault="unqualified">

  <xs:annotation>
   <xs:appinfo>
```

[37] In the GML schema and in GML application schemas, the “nillable with nilReason” construct may be used on elements representing GML properties. This allows properties that are part of the content of objects and features in GML and GML application languages to be declared to be mandatory, while still permitting them to appear in an instance document with no value. Since both simple content and complex content elements may be declared as nillable this construct allows a uniform syntax for properties with void values.

```
    <sch:title>My Schematron validation</sch:title>
    <sch:ns prefix="mns" uri="http://metadata.ces.mil/dse/ns/DISDI/MyNameSpace"/>
   </xs:appinfo>
  </xs:annotation>

  <xs:element name="MyLocation" substitutionGroup="gml:Point"
                                type="mns:MyLocationType">
   <xs:annotation>
    <xs:appinfo>
     <sch:pattern id="MyLocation_srsName">
      <sch:rule context="mns:MyLocation">
       <sch:assert test="@srsName = 'http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84C_3D' or @srsName
= 'http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_2D' or @srsName =
'http://metadata.ces.mil/dse/ns/GSIP/crs/WGS84E_3D'">The srsName must be one of the three WGS84-
based Coordinate Reference Systems.
       </sch:assert>
      </sch:rule>
     </sch:pattern>
    </xs:appinfo>
   </xs:annotation>
  </xs:element>

  <xs:complexType name="MyLocationType">
   <xs:complexContent>
    <xs:extension base="gml:PointType">
     <xs:sequence>
          <!-- extension content omitted -->
     </xs:sequence>
    </xs:extension>
   </xs:complexContent>
  </xs:complexType>

   <!-- further schema content omitted -->
</xs:schema>
```

Similar assertions may be used to constrain the use of values from code list resources for individual domain-specific data types, *e.g.*, the set of allowed values of UoM for a measure.

Both ISO 19136:2007 (GML) and DES.ISM.XML.V5 employ Schematron assertions for a variety of purposes.

The SMIS employs Schematron assertions to declare XML element constraints and co-constraints that cannot be expressed using XML Schema, as well as testing for the:

- Exclusion of XML components that are optional in ISO/TS 19139;

- Adherence to cardinalities as specified in Table 4;
- Restriction of value domains as specified in Table 4 and Table 7; and
- Restriction of code lists to those defined by DSE-based authoritative namespaces as specified in Table 11 and Annex B.2.4.

It is a Recommended Best Practice that users of the SMIS employ Schematron assertions in order to more fully document the complete syntactic rule set for their schemas. This level of increased rigor allows for enhanced automated instance document validation as well as providing more detailed guidance to data providers and consumers as to the allowed range of instance documents that they may be allowed to generate, or required to consume, respectively.

Annex C– ISO/TS 19139 Class 1 Profile

(Informative)

C.1 *Introduction*

Many XML development tools can use XSD files to automate the development of interfaces and applications in a web services environment. In such an environment, it may be advantageous to limit XSD schema definitions to just those that are mandatory or recommended portions of a larger reference schema (or schema set). Doing so eliminates the overhead of managing and processing aspects of the externally-specified encoding that are not relevant.

The resulting XSD is also easier for system developers to directly inspect and comprehend.

This XML-based encoding of the SMIS includes a subset profile of the content of the ISO/TS 19139:2007 XML schema '**gmd**' namespace that:

1. Removes XML elements that are optional in ISO/TS 19139 and 19139-2 (*i.e.*, the *minOccurs* facet value is zero) and are excluded by the NMF.
2. Restricts the cardinality of XML elements required by SDSFIE-M. The usage of some metadata elements is altered to make elements mandatory that are optional in ISO 19115 and 19115-2. These changes to the application schema (SDSFIE-M) are carried through to the XSD encoding schema by changing the *minOccurs* or *maxOccurs* values for some of the metadata elements to allow the XML encoding schema to be used to enforce these profile-specific cardinality revisions.[38]
3. Changes the data type of some XML elements where the SMIS has restricted the domain of values. This ensures a consistent encoding is used when the metadata is instantiated. The XML element definition in the XSD encoding schema corresponding to the ISO/TS 19139 element that is so restricted is appropriately revised.

The result of this transformation is the XML schema definition file *smisGmdProfile.xsd*.

The file *smisGmdProfile.xsd* is an ISO 19106 *Geographic information – Profiles* Class 1 profile of ISO/TS 19139 as it is a pure subset of the ISO/TS 19139:2007 XML schema. An XML instance document that is valid with respect to *smisGmdProfile.xsd* will also be valid with respect to the full ISO/TS 19139:2007 XML schema.

The process by which the base ISO/TS 19139 XML schema content model is revised in order to create *smisGmdProfile.xsd* is described in Annex C.3.

This XML-based encoding of the SMIS includes the entire content of the ISO/TS 19139-2:2012 XML schema '**gmi**' namespace.

The file *smisGmiProfile.xsd* is an ISO 19106 *Geographic information – Profiles* Class 1 profile of ISO/TS 19139-2 as it is a full set of the ISO/TS 19139-2:2012 XML schema. An XML instance document that is valid with respect to *smisGmiProfile.xsd* will also be valid with respect to the full ISO/TS 19139-2:2012 XML schema.

[38] A future version of this profile will additionally specify the use of Schematron (ISO/IEC 19757-3:2006) assertions to enforce other types of constraints.

C.2 *ISO/TS 19139 XML Schema Structure*

In the development of ISO/TS 19139 a set of transformation rules were specified in order to ensure the conceptual schema of ISO 19115 was consistently encoded as an XML schema. One consequence of their application is the resulting set of ISO/TS 19139 XSD files corresponds to ISO 19115 UML packages.

Table 16 lists the ISO 19115 UML package and the ISO/TS 19139 XSD file that defines the XML schema for the UML classes in that package. The packages listed in gray are not used by SDSFIE-M; XML components from the corresponding XSD are not used in the *smisGmdProfile.xsd* profile.

Table 16 – ISO 19115 UML Package and the Corresponding ISO/TS 19139 XML Schema Definition Files

ISO 19115 UML Package Name	ISO/TS 19139 XML Schema File Name
Application Schema information	applicationSchema.xsd
Citation and responsible party information	citation.xsd
Constraint information	constraint.xsd
Content information	content.xsd
Data Quality information	dataQuality.xsd
Distribution information	distribution.xsd
Extent information	extent.xsd
Identification information	identification.xsd
Maintenance information	maintenance.xsd
Metadata application information	metadataApplication.xsd
Metadata entity set information	metadataEntity.xsd
Metadata extension information	metadataExtensions.xsd
Portrayal catalogue information	portrayalCatalogue.xsd
Reference system information	referenceSystem.xsd
Spatial representation information	spatialRepresentation.xsd

Table 17 lists the ISO 19115-2 UML package and the ISO/TS 19139-2 XSD file that defines the XML schema for the UML classes in that package. Because all of ISO/TS 19139-2 is used in SDSFIE-M, all of the content of the XML Schema files listed below are contained in the *smisGmiProfile.xsd* file.

Table 17 – ISO 19115-2 UML Package and the Corresponding ISO/TS 19139-2 XML Schema Definition Files

ISO 19115-2 UML Package Name	ISO/TS 19139-2 XML Schema File Name
Acquisition – Imagery information	acquisitionInformation.xsd
Content– Imagery information	contentInformation.xsd
Data Quality– Imagery information	dataQualityInformation.xsd
Metadata entity set – Imagery information	metadataEntity.xsd
Spatial representation – Imagery information	spatialRepresentationInformation.xsd

C.3 *Profile Generation Process*

The file *smisGmdProfile.xsd* is a subset of the contents of the set of ISO/TS 19139 XSD files that compose the '**gmd**' namespace. It imports, as necessary, the XSD files for the related namespaces: '**gco**', '**gss**', '**gsr**', '**gts**' and '**gml**' (see Table 3).

XML definitions in *smisGmdProfile.xsd* have been modified according to the Class 1 profiling rules of ISO 19115 and ISO 19106 *Geographic information – Profiles*. In addition to removing the unused, optional metadata components from the encoding schema, the *smisGmdProfile.xsd* is modified by revising the cardinality of the metadata elements that are required by the SMIS and by changing the data type of some elements where the SMIS has restricted the domain of values.

The process of creating *smisGmdProfile.xsd* was to start with the NMIS '**gmd**' profile and to modify it based on the differences between SMIS and NMIS. SMIS removes fewer elements from ISO 19115 than does NMIS and many elements were returned to the as *smisGmdProfile.xsd* a result. The cardinality of many elements differed as well and those differences were captured by modifying the element cardinailities. For an interesting and insightful read about the process of profiling ISO19115 for NMIS, see Annex D of that specification.

The file *smisGmiProfile.xsd* is a subset of the contents of the set of ISO/TS 19139 XSD files that compose the '**gmi**' namespace. It imports, as necessary, the XSD files for the related namespaces: '**gco**', '**gss**', '**gsr**', '**gts**' and '**gml**' (see Table 3).

XML definitions in *smisGmiProfile.xsd* have not been modified because SDSFIE-M does not specify any changes to cardinality or data types.

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